

International Web Conference

Perspective on Agricultural and Applied Sciences
in COVID-19 Scenario (PAAS-2020)

October 4-6, 2020

Editors

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Dr. Rajendra Singh
Prof. Amar P Garg
Prof. Sumpam Tangjang
Prof. Attia Ahmed Mansour El-Gayar
Prof. C. P. Singh
Mr. Kota Chakrapani

SOUVENIR

Jointly organized by



Agricultural & Environmental Technology Development Society (AETDS)

U.S. Nagar, Uttarakhand, India

Email: paasconference@gmail.com, Website: www.agetds.com

INTERNATIONAL WEB CONFERENCE

Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)

First Edition 2020

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ISBN: Applied

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Published & Printed by:

Agricultural & Environmental Technology Development Society (AETDS),

F-118, Alliance Kingston Estate, Rudrapur 263153, U.S. Nagar, UK, India

Website: www.agetds.com, e-mail: secretary@agetds.com

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Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)

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Editors

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বাংলাদেশ কৃষি গবেষণা ইনস্টিটিউট

কৃষিই সমৃদ্ধি

Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701

Message



It is very much encouraging and delighting that a contemporary International Online Conference on “Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)” is going to be organized by the Agricultural and Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarkhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (SIET), Meerut, India; Soil, Water and Environmental Research Institute (SWERI), Agricultural Research Center (ARC), Giza, Egypt; Rajib Gandhi Central University (RGCU), Itanagar and Corteva Agriscience during 04-06 October 2020. Under the present pandemic circumstance and regular advent of natural disasters, farmers and their farming have become more challenging

and vulnerable to ensure food and nutritional security. The linkages between agricultural and applied sciences are essential to overcome the pandemic situation. More importantly, concerted efforts should be made by relevant institutions by ensuring participations of peoples to cope with the impacts of the novel pandemic. The web based international conference has been designed to focus on various scientific tracks covering major areas of research on agriculture, biological and applied sciences to explore the impacts of pandemic COVID-19 on food security, and the ways in which scientists, researchers, business bodies, policy makers and susceptible households/farmers respond. In addition, the participation of the policy makers, business representatives, research fellows, the members of scientific community including scientists, researchers and distinguished professors will find out the key problems, challenges and their pragmatic solutions that definitely will strengthen the in-depth understanding of the impacts and the way-out the farmers and other stakeholders could adopt to deal with the badly impacts of the novel COVID-19 on agriculture. The interactive participations of peoples from different communities and different parts of the world will help know each other's activities and plans to combat the emerging situations. I do believe that the outcomes of the International Conference will help policy makers to formulate plans and take immediate actions appropriate for ensuring food and nutrition security and resilience of the farmers in the region and ultimately in the world.

I would like to confidently express that the web conference will give avenues to the problems offered by the COVID-19 pandemics to farmers and farming through constructive discussion on the perspectives on the agricultural and other applied sciences during the ongoing situations. Finally, the conference will help devise the innovative solutions to global issues novel in its nature due to the pandemic.

I would like to appreciate the organizing institutes of the contemporary conference and thank people whose dedicated efforts and creative plans will make the conference fruitfully happen.

Date: 15 September, 2020

Director General

प्रो. साकेत कुशवाहा
कुलपति
Prof. Saket Kushwaha
Vice Chancellor



राजीव गाँधी विश्वविद्यालय
केंद्रीय विश्वविद्यालय
रोनोहिल्स, दोड़मुख- ७९१ ११२
अरुणाचल प्रदेश, भारत
Rajiv Gandhi University
Central University
Rono Hills, Doimukh – 791 112
Arunachal Pradesh, India

September 7, 2020

MESSAGE

It gives me immense pleasure to know that the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Res. Inst. (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva Agriscience are jointly organizing a Web International Conference on the topic “Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario” during October 4-6, 2020.

The central theme of the conference “Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario” is of global relevance today. The world is facing tremendous pressure on its limited agriculture resources due to the ever-expanding population in the developing countries, eventually resulting in ecological imbalance. Therefore, there is a great need for institutional efforts and people's participation to address the issues related to the conservation of natural resources for food security and life in general. I am sure that this International Web Conference on "Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)" will focus on the various scientific tracks covering major areas of research on agriculture, biological and applied sciences and become a platform for bringing together the global scientific community including policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas and innovative approaches and solutions.

During the three days of the Conference, the eminent speakers, researchers and scientists will cover the theme from different perspectives which will definitely provide suitable solutions to the global issues. I can confidently say that this conference will offer to discuss the practical problems and challenges and offer solutions to be adopted by workers and researchers in their respective fields.

The success of this Conference will solely be on the dedication and efforts of the innumerable people who have been working tirelessly in every way to make sure this Conference fulfills its objectives in totality. I forward my appreciation and best wishes to all the institutions involved in organizing this prestigious Online International Conference.

I wish this three-day International Conference a grand success.

Saket Kushwaha

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Amar P. Garg

Vice Chancellor

M.Sc., Ph.D., LL.B., F.B.S., F.P.S.I., F.S.M.P., M.N.A.Sc., F.N.R.S., CAS Fellow (U.K.), DAAD Fellow (Germany);

Sectional President (2020-21) - Environmental Science, 108th Indian Science Congress

Ex-Professor & Head, C.C.S. University, Meerut | Former-PVC, JNU, Jaipur

Dated: 10-09-2020



I am delighted to know that Agricultural and Environment Technology Development Society (AETDS) Uttarakhand, India, Shobhit Institute of Engineering & Technology (Deemed-to-be-University), Meerut; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Soils, Water and Environmental Research Institute, Agriculture Research Centre, Giza, Egypt and Rajiv Gandhi Central University, Itanagar, Arunachal Pradesh are collectively organizing International Web Conference on "Perspective on Agricultural and Applied Sciences in Covid-19 Scenario (PAAS-2020) from October 4-6, 2020.

The organizers have very thoughtfully selected the most relevant topic in the present context of COVID-19 pandemic which has compelled the world under lockdown. Except Agriculture, the economy in all sectors has witnessed negative growth throughout the world. The farmers have face great difficulties in selling their produce due to lockdown and their income have been reduced due to local demand and supply. The conference will provide an excellent opportunity for active interaction with great international Professors and prominent agriculturalists and epidemiologists to discuss various issues of impact of COVID-19 pandemic on agricultural production and agribusiness. I hope that the participants will take fullest advantage of this international web conference with the presence of intellectual mix of agriculturists, microbiologists, epidemiologists, economists and business professionals.

I wish all success to the organizers.

(Prof. Amar P. Garg)
Vice-Chancellor



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Prof(Dr) R.H Dahiya

Vice Chancellor

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It gives me immense pleasure that Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Res. Inst. (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva Agriscience are jointly organizing a Web International Conference on "Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario" during October 4-6, 2020.

The central theme of the conference is "Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario" which is very appropriate in the present times globally. A lot of pressure on population with limited agriculture resources in the developing countries that eventually results in ecological imbalance. Therefore there is a great need for institutional efforts as well as people's participation to address the conservation of natural resources for food security and the life in general. Surely International Web Conference on "Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)" will focus on various scientific tracks covering major areas of research on agriculture, biological and applied sciences. This conference shall be a platform to bring together the global scientific community, policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas and innovative approaches and solutions.

I am privileged to say that this conference will offer to discuss the practical problems and challenges and solutions to be adopted by the respective workers. I hope the eminent speakers, researchers and scientists will cover the theme from different perspectives which will definitely offer suitable solutions to the global issues.

The success of this Conference is solely on the dedication and efforts of innumerable people who have been working hard on the preparations in many ways to make sure this Conference becomes a reality.

I express my special thanks and appreciation to all institutions involved and to the organizers of this prestigious international conference.

I wish you all a fruitful discourse.

Best Wishes and Thank you.



Agricultural & Environmental Technology Development Society

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Ref: AETDS/ SO/201

Date: 15.11.2020

Dr. C.P. Singh

President



MESSAGE

It's a matter of great pleasure that the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India organizing the International Web Conference on “**Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)**” with the collaboration of Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Res. Inst, (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva agriscience on October 4-6, 2020.

In this context, emphasis will be on novel tools and technologies in the field of Agricultural and Allied Science, Medical Science, Social Sciences, Biological, and Physical Sciences. This conference will bring together the global scientific community, policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas. It will be an opportunity of sharing our expertise and experience with renowned speakers from all over the world. It will also be a platform to strengthen the friendship and collaboration among the scientists, academia, and the institutes. The various subthemes of the conference will offer many opportunities to delegate to learn new things and apply the same in their respective workplace.

I am very happy to organize the International Web Conference PAAS-2020 on current issues pertinent to Agricultural and Applied Sciences management in COVID-19 Scenario.

I welcome all delegates and wish the conference a grand success.

(Prof. C. P. Singh)
Conference Director & President AETDS
Former Prof. GBPUAT, Pantnagar



Prof. Attia El Gayar
Soil, Water and Environmental Research Institute (SWERI),
Agriculture Research Centre (ARC), Giza, Egypt
attiaelgayar@yahoo.com

SEPTEMBER 10, 2020

MESSAGE

It gives me immense pleasure to know that the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Res. Inst, (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva Agriscience are jointly organizing a Web International Conference on the topic “**Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario**” during October 4-6, 2020.

The central theme of the conference “Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario” is of global relevance today.

The world is facing tremendous pressures on its limited agricultural resources due to the continuous population increase in developing countries, which ultimately led to an environmental imbalance. Therefore, there is a great need for institutional efforts and people's participation to address issues related to preserving natural resources for food security and life in general.

I am sure that this international web conference on “Perspective on Agricultural and Applied Sciences in the COVID-19 Scenario (PAAS-2020)” will focus on the various scientific tracks covering the main areas of research in agriculture and biological and applied sciences and will become a platform for bringing together the global scientific community Including policy makers, administrators, industry representatives and other stakeholders to exchange and share experiences, new ideas, innovative approaches and solutions. During the three days of the conference, prominent speakers, researchers and scholars will cover the topic from different perspectives which will definitely provide appropriate solutions to global issues. I can confidently say that this conference will provide a discussion of practical problems and challenges and present solutions that workers and researchers adopt in their respective fields.

Success of this conference will only be on the dedication and efforts of countless people who have worked tirelessly and in every way to make sure that this conference achieves its objectives in its entirety. I offer my appreciation and best wishes to all the institutions involved in organizing this prestigious international online conference.

I wish this three-day International Conference grand success.

Prof. Attia El Gayar



राजीव गांधी विश्वविद्यालय
RAJIV GANDHI UNIVERSITY

भारत के संसद के अधिनियम द्वारा वर्ष 2007 में स्थापित किया गया
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Message

Prof. Sumpam Tangjang
Coordinator, Agriculture Sciences

I am overwhelmed to learn that the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Research Institute (SWERI), Agriculture Research Center (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva agriscience are jointly organizing a Web International Conference with a central theme "Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario" during October 4-6, 2020.

The world in the present situation is in need of surplus production of food in order to meet the food demand especially in developing nations where hunger is still one of the major issues. Globally, during a Pandemic like Covid-19, many significant works had come to a halt for a while which had direct or indirect effect on the economy of many nations. Also, issues such as food security, conservation of resources, etc. are to be addressed with utmost importance. Therefore, at this juncture, it is a major and appropriate initiative taken up by the collaborating institutions across the world to address the "Perspective on Agricultural and Applied Sciences in COVID-19 (PAAS-2020) Scenario" which will pave a way for sharing of new ideas, experiences, creative imaginations, innovations and formulas to find better solutions for the ongoing issues globally. Such kind of programs could play a vital role in making the world a better place and also make it ever ready to tackle any difficult situations in the near future.

I believe that this conference will provide the delegates with great opportunities to learn new things and apply the same wherever needed. I am confident that the participants are going to experience ideal sessions and will acquire full advantage out of it. I hope the scientists; researchers and eminent speakers will cover all appropriate topics related to the theme and discuss solutions on different issues.

I wish the conference a grand success!

Thank you.


(Prof. Sumpam Tangjang)



বাংলাদেশ কৃষি গবেষণা ইনস্টিটিউট
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Message



This gives me an enormous pleasure that the Agricultural and Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India is going to organize an International Web Conference on ‘Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)’ in collaboration with several Universities, research institute and centers from around the world on October 4-6, 2020 to focus various scientific areas of research on agriculture, biological and applied sciences. I feel privileged and delighted to be a part of this international web conference.

The intensity of the sudden stop induced by the COVID-19 outbreak produces effects on agricultural and applied sciences which are similar to those of a largescale, extreme, natural disaster. Wherever, agriculture and applied sciences are the major contributors to the economy of many developing and developed nations. The present COVID-19 pandemic immensely hampered these two sectors. Indeed, any effect on agriculture will directly impact on the feeding of world population. However, the current coronavirus (COVID-19) outbreak has shed light on unorthodox digital options, as opposed to ‘business as usual’ conference set-ups. Nevertheless, these recent developments are far from being all there is to say about virtual conferencing. For sure, this PAAS-2020 web conference will generate and disseminate knowledge and experience of the participants to face and overcome the barriers in agriculture, applied science and other research activities engendered through COVID-19.

I am grateful as local organizer to the researchers, students, academicians of national and international level and others who have offered their collaboration by submitting constructive papers and abstracts for this conference. I am also indebted to the members of the organizing committee and sub-committees of the conference, sponsors and others who set their endeavors for arranging the event.

I wish the conference an eminent accomplishment in achieving its goal and express my best wishes for the success of the events.

Date: 18 September 2020

Dr. Md. Motiar Rohman
Organizing Secretary



**Dr. Sanjay-Swami, Professor (SSAC)
& Organizing Convener: PAAS-2020**
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MESSAGE

It is indeed a matter of great pride for me in organizing the International Web Conference on "Perspective on Agricultural and Applied Sciences in COVID-19 Scenario" (PAAS-2020) from 4th to 6th October 2020 in virtual mode jointly organized by the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India, Bangladesh Agricultural Research Institute (BARI), Gazipur, Dhaka, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Modipuram, Meerut, India; Soils, Water and Environmental Research Institute (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and CORTEVA agriscience; in collaboration with *Journal of Experimental Biology and Agricultural Sciences* (JEBAS), and *Journal of Post Harvest Technology* (JPHT).

The world has been put in a Great Lockdown with implementing necessary quarantines and social distancing practices to contain the Covid-19 pandemic. The magnitude and speed of collapse in activity that has followed is unlike anything experienced in our lifetimes. The Covid-19 lockdown throughout the world had severely affected all walks of life, particularly lives and livelihoods of the smallholder farmers across rural areas. Smallholder farmers are a crucial part of the food value chain as well as a critical element of the global food system. Mapping and optimizing supply chains will be a key for future resilience. As we adjust to a new normal and business as unusual, it is imperative to leverage the lessons from the pandemic and the severe impacts it has had on the society as a whole and farming community, in particular.

I am confident that this International Web Conference will deliberate on all the related issues and will come out with the recommendations that that how science and technology can serve as a saviour under Covid-19 like situations, and will formulate guidelines to face the challenges ahead.

I wish the International Conference a grand success.

(Sanjay Swami)

Dated: 21-09-2020

☎ 01336-252229, 251665, 252107



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GOCHAR MAHAVIDYALAYA, RAMPUR MANIHARAN, SAHARANPUR (U.P.)

Dr. Harikesh Singh
Associate Professor, Entomology,
Gochar Mahavidyalaya, Rampur Maniharan-247151
Saharanpur, Uttar Pradesh, India



Message from Organising Chairman's Desk

I am profoundly indebted and extremely privileged to be the Organising Chair of the International Web conference on "Perspective on Agricultural and Applied Sciences in COVID-19 scenerio" at online platform organised by Agricultural and Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India jointly organised by Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh; Shobhit Institute of Engineering and Technology (Deemed to be University), Meerut, India; Soils, Water and Environmental Research Institute (SWERI) Agriculture Research Centre (ARC), Giza, Egypt; Rajiv Gandhi Central University, Itanagar, India and Corteva Agri Science. The objective of this conference is to provide a sustainable solution to Agriculture and other Applied fields which are facing a very high pressure of pandemic worldwide.

I am indeed happy to chair second time the international conference of AETDS. I hope the deliberations and sharing the core ideas in different expertise fields will also be launching pad for the solutions of challenging issues of food and environmental security of the world especially developing countries like India who are fighting with exponential population growth. I hope the interactions, exchange of knowledge and collaborations amongst the world's leading experts in these domains will provide a roadmap for such an odd situation of pandemic".

I take this opportunity to congratulate the organising team for the relentless efforts taken to run the show in the most befitting way. I must consider this occasion as a special privilege to sincerely thank the AETDS society for chairing this event and fruitfully supported to carry this endeavour. Further I thank all the resource persons who have done wonderful deliberations during the sessions.

Dr. Harikesh Singh



Agricultural & Environmental Technology Development Society

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Ref:AETDS/SO/203

Date: 01.10.2020



From The Desk of Chief Organizing Secretary

It is a matter of great privilege for me to organize the **International Web Conference on “Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)”** Jointly Organized by the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh; Shobhit Institute of Engineering & Technology (A NAAC Accredited, Deemed to be University), Meerut, India; Soils, Water and Environmental Res. Inst. (SWERI), Agriculture Research Center, (ARC) Giza, Egypt, Rajiv Gandhi Central University, Itanagar, and Corteva agriscience on **October 4-6, 2020**.

On behalf of the organizing committee, I warmly welcome all participants, delegates, researchers, scientists, students from different institutions, colleges, and universities from India and abroad.

PAAS 2020 has been designed to focus on various scientific tracks covering major areas of research on agriculture, biological, and applied sciences. In this context, emphasis pointed on novel tools and technologies in the field of Agricultural and Allied Science, Medical Science, Social Sciences, and Biological Sciences. This conference will bring together the global scientific community, policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas. The conference is aimed to provide a common platform to scientists, researchers, academicians, professionals, social workers, policymakers as well as farmers and expertise corporate to exchange their new ideas and recent research findings with colleagues, which will boost their knowledge and experience. In this global event scientists across the world are participating.

The organizing committee has been very active and arrangements are well underway to ensure that International Web Conference on **“Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)”** is a resounding success. I appeal to the research community to extend their continued support and cooperation to the future activities of AETDS.

I look forward to welcoming you all and pray almighty to bless us for making PAAS 2020 a grand success.

(Dr. Wajid Hasan)

Chief Organizing Secretary, **PAAS-2020**

Secretary, AETDS, Society

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LEAD PAPERS

MANAGING SOIL HEALTH THROUGH ON-FARM NUTRIENT RESOURCES IN THE COVID-19 SCENARIO

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India declared the largest three-week COVID-19 nation-wide lockdown from 25th March to 14th April, 2020 in the initial phase, which has subsequently been extended multiple times till 3rd May, 17th May, and 31st May, 2020 (https://en.wikipedia.org/wiki/COVID-19_pandemic_lockdown_in_India). This national lockdown has severely affected all walks of life, particularly lives and livelihoods across rural India. Agriculture and allied sectors employ more than half of the workforce in the country. Majority of India's farmers (85%) are small and marginal farmers with less than two hectares of land. While the Government of India announced several measures, including exemption of agriculture and fisheries from lockdown restrictions in late March, there has been lacuna in delivery and implementation at the ground level. Going forward, one can foresee many challenges as farmers set out to rebuild their lives and livelihoods. The India Meteorological Department predicts a favorable monsoon during 2020. This is indeed good news in the COVID-19 scenario, assuming agriculture can practice largely unscathed. However, the non-availability or acute shortage of chemical fertilizers poses a big challenge for the farmers in supplying proper nutrition to crops. Although, the data released by the Ministry of Chemicals and Fertilizers indicates that the POS sale of fertilizers to farmers was 10.63 lakh MT which is 32 percent higher than the last year sale of 8.02 lakh MT during first 22 days of April (Sanjay-Swami, 2020a), yet the ground reality indicates that the farmers, particularly small and marginal farmers in rural areas, are facing acute problems on account of non-availability or shortage of chemical fertilizers in the country. Agriculture, by its nature, depletes essential nutrients from the soil and, if soils are to remain productive, nutrients will have to be replaced either by chemical fertilizers, organic fertilizers and farming practices or a combination. Even the best agricultural soils will be eventually depleted if nutrients are not replenished in some way. Therefore, in this critical situation of non-availability/shortage of chemical fertilizers due to COVID-19 lockdown, the farmers must be aware about how they can efficiently manage the proper nutrition to crops. The present paper will provide an insight to the farmers on the availability and usefulness of supplementary on-farm nutrient resources to enrich the soil for better crops in the COVID-19 lockdown scenario.

It is very essential for farmers to integrate skills and knowledge to recycle their own on farm resources and create an effective source of plant nutrients for cultivation of crops with higher productivity (Sanjay-Swami, 2017a). The various options for nutrient management, excluding chemical fertilizers, are being discussed here under in detail:

1. Incorporation of crop residue:

In India, there is a great potential for utilization of crop residues/straw of some of the major cereals and pulses. About 50 per cent of the crop residues are utilized as animal feed, the rest could be very well utilized for recycling of nutrients (Sanjay-Swami, 2017b). Adequate care is required to use the residues after proper composting with efficient microbial inoculants. While the incorporation of crop residues like wheat and rice straw as such or inoculated with fungal species had beneficial effects on crop yields and important in physico-chemical properties of soil (Sanjay-Swami, 2012a).

2. Addition of organic manure:

The organic manure is derived from biological sources like plant, animal and human residues. Organic manure act in many ways in augmenting crop growth and soil productivity. The direct effect of organic manure relates to the uptake of humic substances or its decomposition products affecting favourably the growth and yield of plants (Sanjay-Swami, 2018a). Indirectly, it augments the beneficial soil microorganisms and their activities and thus increases the availability of major and minor plant nutrients.

Bulky organic manure: It generally contains lesser amounts of plant nutrients as compared to concentrated organic manure. It includes FYM, Compost and Green manure.

FYM: It refers to the well-decomposed mixture of dung, urine, farm litter and left over or used up materials from roughages or fodder fed to the cattle. The waste material of cattle shed consisting of dung and urine soaked in the refuse is collected and placed in trenches about 6 m long, 2 m wide and 1 m deep. Each trench is filled up to a height of about 0.5 m above the ground level and plastered over with slurry cow-dung and earth. The material is allowed to decompose undisturbed 3-4 months for anaerobic microorganism for completion of fermentation. FYM becomes ready to apply after 3-4 months. Well-rotted FYM contains 0.5% N, 0.2% P₂O₅ and 0.5% K₂O (Sanjay-Swami, 2017c).

Compost: Large quantities of waste material are available as vegetable refuse, farm litter, such as weeds, stubble, bhusa, sugarcane trash, sewage sludge and animal waste in houses and in areas like human and industrial refuse; therefore, excreta can be converted into useful compost manure by conserving and subjecting these to a controlled process of anaerobic decomposition (Sanjay-Swami, 2020b). Compost is used in the same way as FYM and is good for application to all soils and all crops.

Green manuring: It is a practice of ploughing or turning into the soil under-composed green plant tissues for the purpose of improving physical structure as well as fertility of the soil. It consists of the growing of quick growing crop and ploughing it under to incorporate it into the soil. The green manure crop supplies organic matter as well as additional nitrogen, particularly if it is a legume crop, which has the ability to fix nitrogen from the air with the help of its root-nodule bacteria. A leguminous crop producing 25 tones of green matter per hectare will add about 60 to 90 kg of nitrogen when ploughed under. This amount would equal an application of 3 to 10 tones of FYM on the basis of organic matter and its nitrogen contribution (Sanjay-Swami *et al.*, 2021). The green manure crops also exercise a protective action against erosion and leaching. The most commonly used green manuring crops are: Sunhemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Cluster bean (*Cyamopsis tetragonoloba*), Senji (*Melilotus parviflora*), Cowpea (*Vigna catjang*, *Vigna sinensis*), Berseem (*Trifolium alexandrium*).

3. Vermicompost:

Farmers can prepare vermicompost at their fields very easily. It is produced as the vermi-cast by earth worms feeding on biological waste material and plant residues. The average nutrient content of vermicompost is much higher than that of FYM. It contains 1.60% N, 5.04% P₂O₅ and 0.80% K₂O with small quantities of micronutrients. Application of vermicompost facilitates easy availability of essential plant nutrients to crop. It has been emerging as an important source in supplementing/substituting chemical fertilizers in agriculture (Sanjay-Swami, 2019a). Besides higher concentration of available nutrients (macro, secondary and micro) than the ordinary FYM, it has also been reported to enhance plants ability to fight against insect pests and diseases (Sanjay-Swami, 2012a). Vermicompost also improves soil structure due to presence of soil binding chemicals and improves physical properties of the soil like soil air, soil temperature, soil water retention and soil mechanical impedance (Sanjay-Swami and Bazaya, 2010). Due to non-presence of toxic enzymes it is also eco-friendly and it also has beneficial effect on the bio chemical activities

of the soil (Sanjay-Swami and Bazaya, 2011). There is a growing realization that vermicomposting provides the nutrients and growth enhancing hormones necessary for plant growth (Sanjay-Swami, 2019a). The fruits, flowers and vegetables and other plant products grown using vermicompost are reported to have better keeping quality (Sanjay-Swami, 2020c).



Plate 1 & 2: Green manure crop and its incorporation in soil

Compost pit of any convenient dimension can be dug in the field. The most convenient pit of easily manageable size is 2m x 1m x 0.75m. A tank may be constructed with brick and mortar with proper water outlets, or a plastic crate (600 mm x 300 mm x 300 mm) with holes drilled at the bottom. To make it simpler it can also be done in a 25-litre bucket. Vermi-bed (vermes= earthworms; bed= bedding) is the actual layer of good moist loamy soil placed at the bottom, about 150 to 200 mm thick above a thin layer (50 mm) of broken bricks and coarse sand. Earthworms are introduced into the loamy soil, which the worms will inhabit as their home. About 100 earthworms (a combination of *epigeics* and *anecics*) may be introduced into a compost pit of about 2m x 1m x 0.75m, with a vermin-bed of about 15 to 20 cm thick. The vermi-bed should always be kept moist, but should never be flooded. Handful lumps of fresh cattle dung are then placed at random over the vermi-bed. The compost pit is then layered to about 50 mm with dry leaves or preferably chopped hay/straw. For the next 30 days the pit is kept moist by watering it whenever necessary. The bed should neither be dry nor soggy. The pit may then be covered with an old jute (gunny) bag to discourage birds. Plastic sheets on the bed are to be avoided as they trap heat. After the first 30 days, as above, wet organic waste of animal and/or plant origin from the farm that has been pre-digested is spread over it to a thickness of about 50 mm. This can be repeated twice a week. All these organic wastes can be turned over or mixed periodically with a pick axe or a spade. Care should be taken not to disturb the vermi-bed in which the worms live. Keep adding garbage till the compost pit is nearly full. Continue to keep the pit moist for another 30 to 45 days, turning over the material in the pit with care avoiding injury to the worms. Turning over can be done on every fifth or seventh day with the help of a forked spade. Regular watering should be done to keep the right amount of moisture in the pits. In 60 to 90 days the compost should be ready as indicated by the presence of earthworm castings (vermi-compost) on the top of the bed. The compost should be turned occasionally since this allows for aeration. If the weather is very dry it should be dampened periodically. Vermicompost can now be harvested from the bin/pit. The material should be placed in a heap in the sun so that most of the worms move down to the cool base of the heap. The compost is then sieved before being packed. The earthworms and the thicker material, which remains on top of the sieve, go back in the bin and the process starts again. Compost works best with a mixture of coarse and

fine materials, layered together. The extra worms that are produced can be used as feed for poultry and fish

4. Vermiwash:

Foliar sprays are a part of organic production practices. Worm worked soils have burrows formed by the earthworms. Bacteria richly inhabit these burrows, also called as the drilospheres. Water passing through these passages washes the nutrients from these burrows to the roots and being absorbed by the plants. This principle is applied in the preparation of vermiwash. Vermiwash is a very good foliar spray.

Setting up of vermiwash unit:

Vermiwash units can be set up either in barrels or in buckets or even in small earthen pots. It is the principle that is important. The procedure explained here is for setting up of a 250 litre barrel. An empty barrel with one side open is taken. On the other side, a hole is made to accommodate the vertical limb of a 'T' jointed tube in a way that about half to one inch of the tube projects into the barrel. To one end of the horizontal limb is attached a tap. The other end is kept closed. This serves as an emergency opening to clean the 'T' jointed tube if it gets clogged. The entire unit is set up on a short pedestal made of few bricks to facilitate easy collection of vermiwash (Sanjay-Swami, 2017a). Keeping the tap open, a 25 cm layer of broken bricks or pebbles is placed. A 25 cm layer of coarse sand then follows the layer of bricks. Water is then made to flow through these layers to enable the setting up of the basic filter unit. On top of this layer is placed a 30 to 45 cm layer of loamy soil. It is moistened and into this, about 50 numbers each of the surface (*epigeic*) and sub-surface (*anecic*) earthworms are introduced. Cattle dung pats and hay is placed on top of the soil layer and gently moistened. The tap is kept open for the next 15 days. Water is added every day to keep the unit moist. On the 16th day, the tap is closed and on top of the unit a metal container or mud pot perforated at the base as a sprinkler is suspended. 5 litres of water (the volume of water taken in this container is one fiftieth of the size of the main container) is poured into this container and allowed to gradually sprinkle on the barrel overnight. This water percolates through the compost, the burrows of the earthworms and gets collected at the base. The tap of the unit is opened the next day morning and the vermiwash is collected. The tap is then closed and the suspended pot is refilled with 5 litres of water that evening to be collected again the following morning. Dung pats and hay may be replaced periodically based on need. The entire set up may be emptied and reset between 10 and 12 months of use. Vermiwash is diluted with water (10%) before spraying. This has been found to be very effective on several plants. If need be vermiwash may be mixed with cow's urine and diluted (1 litre of vermiwash, 1 litre of cow's urine and 8 litres of water) and sprayed on plants to function as an effecting foliar spray and pesticide (Sanjay-Swami, 2012b).

5. Panchagavya:

Panchagavya consists of nine products *viz.* cow dung, cow urine, milk, curd, jaggery, ghee, banana, tender coconut and water. When suitably mixed and used, these have miraculous effects.

Cow dung - 7 kg

Cow ghee - 1 kg

Mix the above two ingredients thoroughly both in morning and evening hours and keep it for 3 days.

Cow Urine - 10 liters

Water - 10 liters

After 3 days mix cow urine and water and keep it for 15 days with regular mixing both in morning and evening hours. After 15 days mix the following and panchagavya will be ready after 30 days.

Cow milk - 3 liters

Cow curd - 2 liters

Tender coconut water - 3 liters

Jaggery - 3 kg

Well ripened poovan banana – 12 Nos.

All the above items can be added to a wide mouthed mud pot, concrete tank or plastic can as per the above order. The container should be kept open under shade. The content is to be stirred twice a day both in morning and evening. The Panchagavya stock solution will be ready after 30 days (Sanjay-Swami, 2020c). It should be kept in the shade and covered with a wire mesh or plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots in the solution.

5. Azolla:

Azolla is a free-floating water fern that floats in the water and fix atmospheric nitrogen because of its association with the nitrogen fixing cyanobacterium, *Anabaena*. The *Azolla-Anabaena* association is a live floating nitrogen factory using energy from photosynthesis to fix atmospheric nitrogen amounting to 100-150 kg N/ha/year from about 40-64 tones of biomass. The average N, P and K content in *Azolla* on dry weight basis are 4.0-7.0, 0.6-0.8 and 2.0-4.0 per cent, respectively. With a doubling of biomass within two days, *Azolla* ranks amongst the fastest-growing plants on our planet and thus can provide large bio-mass (Sanjay-Swami and Singh, 2020).

Conclusion:

Recyclable nutrients from plant and animal waste in large quantity can overcome the issue of acute shortage of chemical fertilizers and ultimately in meeting out crop nutrient requirements. The uniqueness of these practices is their suitability to the local conditions, their economic feasibility and easy implementation. These practices would also help the farmers in reducing the cost of cultivation.

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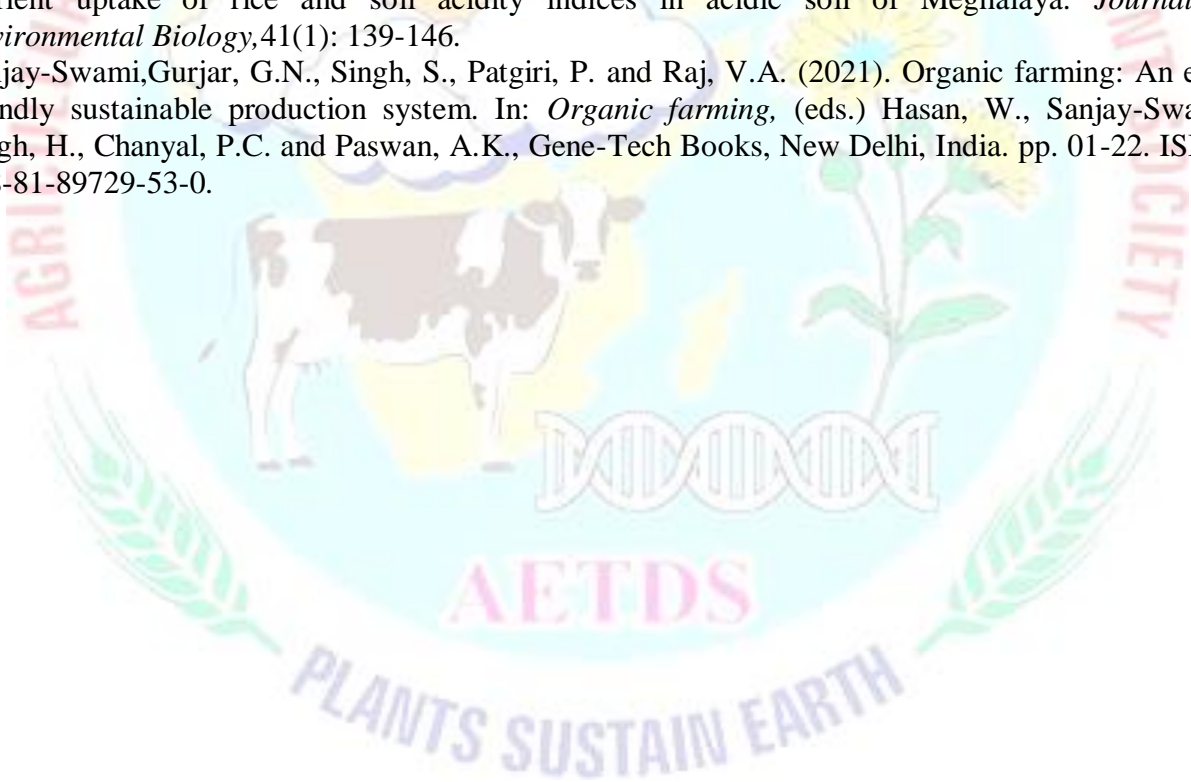
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IMPACT OF NOVEL CORONAVIRUS (COVID-19) PANDEMIC IN INDIAN AGRICULTURE

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Worldwide epidemic infection of Novel Coronavirus (Covid-19) has gotten pandemic all through all the countries since mid-December 2020 and was discovered far and wide event and a flare-up of plague malady with a worldwide sign inside and out over the landmasses which as yet proceeding with fluctuation of degrees. The event and impact are remarkable over the ongoing occasions in India from mid-March 2020. Indian agriculture has been the worst sufferer due to ongoing pandemic and world-wide prolonged lockdown situations that adversely hit agricultural production, productivity, employment security including affected day-to-day agricultural operations of the common agrarian people. Peoples from all walks of occupations seriously either displaced or compelled to shift their means of livelihoods where they became are unfed, underfed, or malnourished with starvation as hopeless and helpless. Thoughtful mechanisms to combat the situation with meaningful strategies have not been found effective to date to control the epidemics despite all-out efforts to get rid of this situation. The suggestive measures have often been declared to withstand against the pandemic but ways of implementations were found not much effective. However, the country would have to find out the ways and means to revamp and reconstruct the economy of the country where agriculture could come forward to show the ray of hope.

Agriculture, being the foundation of the nation's economy has been influenced most exceedingly awful where GDP for farming tumbles down radically where it had been a declining pattern from 15.7% to 4.80 in 2017 to 2020. The economic effect of the COVID pandemic has been to a great extent troublesome and that influenced the farming community harshly. India's GDP, over-all development inside the final quarter of the financial year 2020 went directly down to 3.1% reliable as revealed by the Ministry of Statistics, Government of India. The Chief Economic Adviser to the Government of India said that this drop is particularly because of the COVID pandemic impact. Despite the fact that India had long been suffered a pre-pandemic log jam, and reliable with the World Bank's perceptions that the current pandemic has "amplified previous dangers to India's economic viewpoint". India has found in thirty years since the 1990s, the financial progression genuinely got exceptional disadvantageous situations. Nonetheless, after the declaration of the financial bundle in mid-May, 2020 India's GDP assessed were minimized considerably more too negative figures, flagging a profound downturn. On 26 May, CRISIL (an Indian diagnostic organization giving appraisals, exploration, and danger and strategy warning) reported this may maybe be India's most noticeably terrible downturn since freedom on store monetary foundation of examination. Joblessness rose from 6.7% on 15 March'20 to 26% on 19 April '20 at that point backtrack to pre-lockdown levels by mid-June. An expected 14 crores (140 million) individuals lost work while pay rates were cut for a few others very 45% of families over the state have announced a pay dropped when contrasted with the earlier year during the lockdown. Up to 53% of organizations inside the nation were extended to be essentially influenced. Flexible chains are anesthetizing worry with the lockdown limitations set up; at first, there was a shortage of clearness in smoothing out what a "basic" is and so forth. Those inside the casual divisions and everyday wage bunches are at the principal hazard an outsized number of ranchers around the nation who develop perishables likewise confronted vulnerability. In India, agriculture, with its allied sector, is the biggest stakeholders where 70 % of its provincial

families despite everything rely essentially upon horticulture for, with 85 % of ranchers being little and minor having on a normal of under 2 ha landholding. Absolute food grain creation of the nation was assessed at the tune of 275 million tons (MT) during the year 2017-18 in the midst of all the changes. Rural approaches have seen a significant lift since 2014 where it was chosen to zero in on multiplying ranchers' pay by 2022. The legislature has additionally set a yearning food grains creation focus of 291.1 million tons for 2019-20, an expansion of 2.6% contrasted with the earlier year, referring to a good storm in the ebb and flow season that remembers the green transformation for crops, white upset with dairy and blue unrest with fisheries. Despite the numerous lacunae, the nation should be a worldwide pioneer in agrarian creation. In 2017-18, complete food grain creation was assessed at India is the biggest maker (25% of worldwide creation), shopper (27% of world utilization), and shipper (14%) of heartbeats on the planet. India is perhaps the biggest maker of food grains on the planet (275 million metric ton), and its yield with 157.35 million ha of land to develop, yields from cultivating are low and the weight ashore use is colossal. The biggest arable yield rice (44 million ha) trailed by wheat (30 million ha) where the profitability of both the harvests expanded generously. 85% of the all-out operational property is represented little and minor ranchers in the nation who have fewer than 2 ha of horticultural land which producing 158 million ha or about half the worked region. The normal size of possessions declined from 2.82 ha in 1970-71 to 1.16 ha in 2010-11 where the fracture of cultivatable land which is standard highlights with declined per capita accessibility of the land property. Industrialization, property, and different intentions are sharing the cultivable territory. The farming efficiency is proceeding in the midst of a few financial variables existing. India's agricultural sector largely depends on migrant labourers for several operations. Now, an estimated 50 million migrant labourers (of India's 140 million) are expected to have returned to their native places from a respective place of working following the nationwide lockdown from March 24. These are accounted for about 11% of the non-self-employed labour force. Many migrant labourers, mainly from eastern states, are working in agricultural fields in the country's west and north. They are also significantly employed in marine fishing, post-harvest activities, managing livestock, in marketing, and in the creation of agricultural infrastructure. As such, it appeared that the migrants' return is having a negative impact on agriculturally developed regions, with the proximate cause being the harvest of important *rabi* crops like wheat and mustard, resulting in a higher production cost. If the lockdown continues without adequate mitigation efforts, even the *kharif* crops could be affected. Unless compensated for the loss of labour force, many marine fishing and fish processing activities will also be adversely affected. Supply chain in agricultural commodities where COVID-19 is disrupting activities as per preliminary reports that the non-availability of migrant labor is interrupting some harvesting activities, particularly in northwest India where wheat and pulses are being harvested. There are disruptions in supply chains because of transportation problems and other socio-political issues. Prices have declined for wheat, vegetables, and other crops, yet consumers are often paying more. The closure of hotels, restaurants, sweet shops, and tea shops during the lockdown is already depressing sales. Policymakers, planners as well as social scientists are in search suitable alternative to combat the situations with effective measures.

The need of the hour is to keep the agriculture and allied sectors and supply chains working in agriculture is now depended mostly on the smooth supply of hard cash to the farmers to boost up the purchasing abilities, the supply of agricultural commodities at door-steps with reducing transport cost, implementation of the programme leading to overcome the labor shortages and falling prices of essential commodities that should be rectified to keep supply chains functioning assure food security. Farm populations must be protected from the coronavirus to the extent

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possible by massive and fast testing, using proper sanitization with mask-wearing, and practicing social distancing. Each and every farmer must have continued access to markets with a mix of private markets and government procurement. Small poultry and dairy farmers need more targeted help to maintain nutritional balance in the dietary programme to make sure of maintaining public health where immunity to resist the virus could be developed to give a guarantee of permanent protection as the pandemic-related input's supply and market-access problems are very urgent. Each farmer and agricultural workers should be included in the government's assistance package and any social protection programs to address the present crisis. Lockdown measures are found to be prolonged wherein demand has risen for home delivery of groceries on the adoption of E-commerce be encouraged and be promoted. The government should promote trade by avoiding export bans and import restrictions. Adoptions of these suggestive measures are the guarantee of revamping and rebuild the economy with well-organized and proper planning.

Keywords: Coronavirus (COVID-19); Production & productivity and GDP in agriculture; Supply-chain and remedial measures



**INTEGRATED MANAGEMENT IS AN EFFECTIVE WAY TO TACKLE THE
FUSARIUM WILT-TROPICAL RACE 4- A DEVASTATING DISEASE IN BANANA**

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The banana is one of the economically important staple food crops have been cultivated in more than 150 countries across the globe. International banana trade fetches substantial revenue to the exporting countries and subsistence farmers. Banana and plantains are consumed by more than 400 million people around the world next to grains (e.g. Rice, Wheat and Maize) as it possesses abundant vitamins (A, B and C) and minerals (potassium and calcium). A total of ~1000 banana varieties are being cultivated across the world which has been subdivided into 50 groups. The global banana production estimated to be ~105 million tons per annum. Among various continents, Asia has the lion's share of 60% in global banana production where India is the largest producer contributes 48% (29.724 million tons) of the total production from 39% (0.802 million hectares) of the cropping area with a total worth of Rs. 50,000/- crores. Although several locations specific varieties are largely grown in different parts of the country, the Indian banana export mainly depends on Cavendish clones which occupy 55% of the total area under banana cultivation and contribute 64% of the total banana production.

Among the production constraints, a Fusarium wilt caused by the fungus *Fusarium oxysporum* f. sp. *cubense* (*Foc*) is the most devastating disease affecting commercial banana production throughout the banana-cultivating areas of the world. The disease is ranked as one of the top six important plant diseases in the world. Based on pathogenicity to differential banana host cultivars, *Foc* isolates have been grouped into four physiological races. Race 1 occurs throughout the world and infects cv. Gros Michael, Silk (AAB), Pome (AAB), 'abacá', 'Maqueño' (AAB), 'Pisang Awak' (ABB) and I.C.2' (AAAA). Race 2 mainly infects cv. Bluggoe, Monthan (ABB) and other closely related cooking bananas. Race 3 is a non-pathogenic strain to *Musa* spp. found to infect several species of *Heliconia*. Race 4 occurs in most of the banana-growing regions of the world and is most destructive since it affects race 1 and race 2 susceptible clones as well as the Cavendish cultivars and Pisang Mas (AA). Race 4 is further divided into two groups viz., subtropical race 4 (STR4) and tropical race 4 (TR4) (VCG 01213-01216 complex) and distinguished from each other based on the vegetative compatibility of their strains. STR4 affects Cavendish banana that has been predisposed to disease by cold temperatures in the subtropics. Whereas TR4 attacks Cavendish more aggressively under both tropical and subtropical conditions in the absence of predisposing factors. The strain *Foc* TR4 (VCG 01213) was first designated in Taiwan by Su in 1977 on the basis of wilt in cv. Cavendish and considered to be originated in the Malay Peninsula and Sumatra. Severe damages of *Foc* TR4 on cv. Cavendish has been reported in Malaysia, Indonesia, South China, the Philippines, Northern Territory of Australia, Mozambique, Jordan, Lebanon, Pakistan, Israel, Laos, Vietnam and Myanmar. In India, *Foc* TR4 had been reported in the Katihar and Purnea districts of Bihar and spread further to the states of Uttar Pradesh (Faizabad). As the strain TR4 can spread through planting materials, soils, irrigation water and bunch stalk, there is a chance for the further spread of this devastating strain rapidly to other states. In this case, there is a possibility of incurring a heavy loss to an Indian banana industry that mainly depends on Cavendish clones and hence it would be more catastrophic to the livelihood and sustainability of the banana farmers.

The fungus survives primarily in the soil and on plant debris as chlamydospores for more than 40 years. The pathogen is also able to infect and persist in the roots of several species of weeds and grasses such as *Paspalum*, *Panicum*, *Ixophorus*, *Commelina* and *Chloris inflata* which have been identified as non-symptomatic hosts of the pathogen. *Foc* is most commonly spread by the movement of infected planting material, rhizomes and suckers (and the attached soil), to new uninfected areas. The pathogen can also be effectively spread by the movement of soil, running water, and farm machinery and implements. The spread between the plants within the field is also affected by the roots. Banana weevils such as corm borer *Cosmopolites sordidus* and stem borer *Odoiporus longicollis* (Coleoptera: Curculionidae) may act as a vector in the dissemination or predisposing factor.

As there are no single source effective management practices for Fusarium Wilt available so far, ICAR – NRC for Banana has carried out different component of integrated management practices which includes *Foc* specific marker for early diagnosis of Fusarium wilt disease, development of effective consortia of bioagents for disease suppression and enhancement of yield, finding out resistant sources etc.

In order to assess the distribution *Foc* TR4 in India, a survey was conducted in hotspot areas of disease infestation. Fusarium wilt infected corm samples were collected from six different banana cultivars of which *Foc* TR4 was present only in the cv. Grand Nain and does not in the cv. Neypoovan, Karpuravalli, Rasthali, Sennachenkathali and Big Ebanga where *Foc* TR4 was distributed only in Bihar and Uttar Pradesh.

The occurrence and role of endophytic bacterial communities in different banana genome types under field-grown conditions were explored for the sustainable management of Fusarium wilt. In this direction, the evaluation of native endophytic and rhizospheric bioagents combinations such as *Trichoderma* sp. NRCB3 + *Penicillium pinophyllum* and *Trichoderma asperellum* prr2 + *Bacillus flexus* against *Foc* TR4 under pot culture condition in cv. Grand Nain indicated significant suppression of the disease as compared to *Foc* alone inoculated plants. The maximum disease suppression of 1.12 disease score was observed in the banana plants applied with *Trichoderma* sp. NRCB3 + *Penicillium pinophyllum* and 1.58 disease score in the *Trichoderma* sp. NRCB3 + *Penicillium pinophyllum* applied plants as against 4.43 disease score in *Foc* alone inoculated control plants on the disease scale of 1-6 where one is health without any internal vascular discoloration and six is dead. Besides the application of bioagents also significantly increased the plant growth parameters such as the height of the plant, girth etc.

The multi-location field study conducted in Uttar Pradesh, Bihar and Surat revealed that the experimental plots applied with mass-produced bioagents of endophytic *T. asperellum* + *Penicillium pinophilum* than the control (12.5%) showed less external symptoms (6.25%) with maximum plant height (128.3 cm), plant girth (50.3 cm) and leaf area (5329.6 cm²) when compared to control in three months after application.

As the pathogenicity and the devastation of *Foc* TR4 organism that differs spatially and temporally, understanding the proteome of the fungi may help in designing effective control measures through molecular approaches. A study that was aimed to compare the proteome of the two pathogenic *Foc* virulent strains, *Foc* R1 and *Foc* TR4 that are capable of infecting the Cavendish group of bananas identified several putative pathogenicity related proteins in both *Foc* R1 and *Foc* TR4.

To understand the genome structure and its role of the *Foc* TR4, whole-genome analysis was carried out and the analysis showed that there were 1042 genes present in the genome of *Foc* TR4, in which 20 unique cellular transporters genes were recognized. Also identified variations in secreted in xylem (SIX) protein gene clusters. Besides, by exploring the genome sequences,

recently we have developed race-specific markers and disease detection technique such as LAMP methods that may help in quick and accurate diagnosis of the disease at the field levels.

Recently, a farmers' friendly and economical method of mass production and delivery system has been developed which ensured high-density propagules of bioagents with extended shelf-life for the effective management of Fusarium wilt disease.

Therefore the above said combined efforts such as the survey of *Foc* infestation in hotspot areas, integrated disease management of the disease for the enhancement banana yield using native microorganisms and understanding of the causal agent at proteomic and genomic levels besides development of easy diagnosis method may be the sustainable disease management strategies for the devastating disease and the same will be discussed in detail.

Key Words: Fusarium wilt, Tropical Race 4, Integrated management, Molecular marker



CHALLENGES IN LIVESTOCK SECTOR DURING COVID-19 PANDEMIC

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Livestock plays an important role in the national economy and in the socio-economic development of the country. The sector contributes around 12% to the domestic economy has been badly affected due to nationwide lockdown imposed to curb the spread of coronavirus. The livestock owners, stakeholders and beneficiaries of livestock sector realise severe threats due to disruption in supply chain resulting from difficulty in moving live animals and animal products like milk, meat and eggs to markets, restricted capacity to purchase necessary production inputs, restricted access to labour and services. These difficulties have further led to a decrease in processing capacity for animal products, as well as loss of sales and slow-down of market activity. In such situation, the sector bears several challenges and uncertainties to overcome future possibilities and strategic plan of action to be taken to overcome the impact of crisis. The dairy sector and small ruminant production due to nature of operation and routine activities for effective management are likely to suffer standard animal husbandry practices for animal health and hygiene. The fall in consumption of milk and meat has directly or indirectly affected several farmers associated with the production and delivery of livestock milk, meat and other products. The poultry industry has suffered a biggest negative set back among all sectors in an unprecedented way which is due to its scale of operation and rumours and misconceptions regarding transmission of virus from animals to humans. As such, the vulnerability of livestock sector at the times of crisis should make us re-think for the policies we are working for the revival of sector which could strengthen livestock production as a sustainable and profitable business opportunity.

Keywords: Livestock sector, Covid-19, Economy, Milk

INTRODUCTION

Livestock plays a significant role in national economy and is an important means of livelihoods to most of the poor families living in rural areas. In an estimate, there are about 140 million rural households categorized as small and marginal farmers, a significant part being landless and agricultural labourers who work hard to fulfil their daily needs (Kishore et al. 2019). For them, livestock occupies central position as a part of mixed farming system where they could raise their whole-farm productivity and provide a steady source of income, in addition to food and nutritional security for their family. In country like India, the role of livestock is much beyond what is produced from them, either for direct use or sale of products in local markets. Livestock play many other important roles such as means of self-employment to the farmer and family members, store of wealth in the form of mobile bank, form of insurance to overcome natural calamities, gender equality by generating opportunities for women; recycling waste products and residues from cropping or agro-industries, improving the structure and fertility of soil and controlling insects and weeds, ritual purposes and social status (Moyo et al. 2010). This inter-dependency of man with livestock certainly make us think twice how a sudden change arising due to massive disease outbreak could affect the life of both human as well as animal. The current outbreak of corona virus diseases is one such incidence world is facing today, which has not only changed the ways we live but also disrupted livestock sector in many counties including India.

COVID-19 pandemic has caused a substantial impact on many sectors at global, regional and national levels, including the livestock sector (FAO, 2020). The disease has resulted in biggest negative set back in livestock sector with a severe 'demand shock' across the globe. The current pandemic threatens to disrupt the global economy with fears of recession looming in many countries and has also resulted in acute market volatility, reflecting the unprecedented uncertainty of the situation. The containment measures taken worldwide such as total lockdown, restrictions in movements, and border controls to slow down the spread of disease has hit the industry hard in an unintended or negative way. The livestock owners, stakeholders and beneficiaries of livestock sector realise severe threat due to disruption in supply chain resulting from difficulty in moving live animals and animal products like milk, meat and eggs to markets, restricted capacity to purchase necessary production inputs, restricted access to labour and services. These difficulties have led to a decrease in processing capacity for animal products, as well as loss of sales and slow-down of market activity.

The biggest crisis of all times

The economic crisis unleashed by the outbreak of COVID-19 is hurting economies, regardless of income level. The most recent data from UNIDO's seasonally adjusted Index of Industrial Production (April 2020 vs December 2019) indicate that both lower- and upper middle-income countries have been significantly impacted by COVID-19. As per reports of BBC, the developing world economies are hit hard by coronavirus. Many people have lost their jobs or seen their incomes cut due to the coronavirus crisis. Unemployment rates have increased across major economies as a result. It is forecasted that 2021 would only see a partial recovery in economy.

Impact on livestock and poultry sector

Dairy sector

The dairy and animal husbandry sector contributes around 4.2% of India's GDP. It is a primary source of income for about 7 crore rural families. Most of the milk producers are landless or small and marginal farmers. In an estimate, India produced around 176.4 million tonnes of milk and emerged as leading producer of milk in the world with CAGR of 4.5% as compared to world's average of ~2% (FICCI 2020). The total milk produced in our country is around 560 million litres/day, 70% of which is utilized as raw milk for direct consumption and 30% is handled by organized sector selling as packaged milk or processed dairy products (NDDDB 2019). Now in crisis, there is low consumption of milk products due to the lockdown, largely due to supply and demand issues. Nationally, the dairy cooperatives, organized private sector and informal milk market agents who could procure about 150-160 million litres of milk per day, were not ready to procure milk from producers, disrupting the supply chain and jeopardizing small farmers, leading to sudden drop in milk prices (Kumar et al. 2020). Cooperatives started announcing milk holidays, hotels, restaurants, caterers, and tea shops closed, depressing milk sales further. As a result, there was large scale demonstration and protest made by milk producers in different parts of country, dairy farmers dumping their milk on the streets. The milk demand reduced by 20-25% and the milk business lasts for only a few hours each day.

Small ruminant – Sheep and goat

In many parts of our country there are communities who could earn their livelihood depending on rearing sheep and goat flocks. They rear these species either living a nomadic life, moving with the flock in search of good grazing land and living in tents or huts for temporary accommodation, or settle at one place and remain with the family where they could maintain their agricultural land with other species of livestock. The nomadic group is typically always on the move, looking to find grazing spots for their livestock. They may stay for as little as two or three days in the same place, or as long as two months. The duration of their stay is decided based on weather conditions and

grazing opportunities. In a report which describes the impact of the nationwide lockdown on the shepherd community, it was highlighted that imposition of an unplanned lockdown and the sudden, near-complete ban on transportation and movement had an adverse impact on this community (Muthukumar 2020). Many farmers who waited whole year for festive seasons like holi and eid for sale of their animal, could not sell their animals due to restrictions.

Poultry sector

Poultry is the most organised sector among agriculture-livestock based commodities in India. The Indian poultry market, consisting of broilers and eggs is estimated to have a net worth of 1800 billion with a projected CAGR of 16.2% during over next 5 years. The industry supports over 25 million farmers who are directly engaged in poultry business and additionally employs over 5 million people in allied fields and services such as poultry feed manufacturing, pharmaceuticals sector, trading and logistics, exports, etc (DAHD 2019). The industry was reeling under severe price pressures for the past few months and just when it was hoping for some equilibrium and stability to kick in, COVID-19 struck. The disease led to rumours and misconceptions regarding transmission of virus from animals to humans which affected consumption of poultry products and the shops being closed due to total lockdown. Also there were restrictions on inter-state movement to fulfil the supply. There was drastic fall in the demand of poultry meat and eggs, chicken prices have sharply dropped at the farmgate to 60% below cost of production. According to an estimate the industry suffered loss of Rs 1,500-2,000 crore daily during February and early March (Ministry of Animal Husbandry, Dairying and Fisheries).

Other allied sector and services

Feed industry: The coronavirus has a huge impact on daily life from the man on the street to businesses. And the livestock feed sector in our country, which currently represents one of the largest feed producers in the world, even more essential than ever, has not gone unscathed. Indian feed industry has marked a growth at a CAGR of 8 percent with poultry, aqua and dairy industry occupying the major share in overall feed demand. Now, due to severe crisis in COVID-19 situations, the industry is battling for stability in demand-supply arising from rumours of coronavirus spreading through the consumption of animal products. There is disruption in supply chain due to restriction in movement of vehicles carrying livestock feed, and feed ingredients which has altogether affected the feed market. Another major challenge the industry is facing is raw material price volatility due to shortage in supply.

Inputs and health services: Lockdown restrictions during Covid-19 has severely affected services sector in animal production in terms of non-availability of breeding materials and replacement stocks (e.g. A.I. facilities, day-old chicks etc.). There is disruption of health services combined with interrupted delivery and use of vaccines and medicines which raises likelihood of new epidemics, including those involving animal diseases that may account to major livestock losses.

Processing, value addition and marketing: Staff reductions due to lockdown measures are constraining meat and dairy processing industries in many countries, given their labour-intensive nature. However, despite these odds, the cooperative model in India went out of the way to protect the milk producers by procuring surplus milk from the farmers and using this 'extra' milk in production of skimmed milk powder. In a report, it is estimated that India doubled its production of skimmed milk powder in just one and a half month during lockdown. As per NDDDB, the daily production of milk powder in our country is 1500 metric tonnes during lockdown. Other value added dairy products like paneer, butter, ice-cream recorded a dip in production by 50% due to reduced demand. India's meat industry have also taken a massive hit due to the coronavirus outbreak, with exports falling nearly 50% to around 50,000 tonne in the last one month. The

countries' current buffalo meat processing capacity is of 20 lakh tonne per annum. Buffalo meat exports was 10,04,676 tonne, valued at Rs 19,763.28 crore in the April-January period of 2019-20, according to data from Agricultural and Processed Food Products Export Development Authority (APEDA). In 2018-19, the country exported 12.3 lakh tonne of buffalo meat valued at Rs 25,091 crore.

Way ahead

'The microbe is nothing, the terrain is everything' is one of the last words of Louis Pasteur - the father of modern microbiology and proponent of the 'Germ Theory' of the disease. These words are so apt in today's scenario where we are clueless about this new pathogenic coronavirus, SARS-CoV-2. The time has come to start working on terrain instead of fighting the unknown. COVID-19 outbreak testifies that this virus attacks the person with weak immune system. Nutritious diet, hygiene and healthy lifestyle practices could be the only way out which could boost our immunity. Government should give a push to meet the food and nutritional needs of vulnerable sections of the population. The livestock sector should be treated as opportunity in such crisis to revive the weaker sections and migrants who have returned home to be engaged in the dairy farming or other livestock opportunities. Cluster approach must be vigorously pursued for dairy, poultry, piggery, etc. based on the regional preferences. For this, a huge push may be needed to enhance the flow of agricultural credit to small and marginal farmers and also to informal sectors engaged in livestock production. There should be guidelines for COVID-19 control and prevention along the supply chains to protect value chain actors and their families. These guidelines should include provisions for heightened biosecurity, personal protective equipment and hygiene. The food markets should remain open while facilitating physical distancing via: i) public health-conscious rules, procedures and equipment; and ii) the application of behavioural insights to market processes and environments (biodiversity, land, water, and ecosystems) where diseases flourish. The government should rethink on policies for imports and exports of products relevant to all nodes on the value chain and support trans-boundary movement across the borders.

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IMPACT OF COVID-19 ON FISHERIES IN NEPAL

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Nepal is a land linked country located in South Asia between India and China. Its south, east and west parts are bordered by India while China in the north. It possesses a series of the rocky and inaccessible hilly terrains having more than 6000 rivers. The watersheds with different altitudinal variations from 60m-8848m represents a total of 252 fish species. Among them 236 species are indigenous while 16 species are exotic. In general, fisheries include all living aquatic organisms having economic value. The fisheries can be differentiated into capture, enhanced or culture based and aquaculture which indicate no control, partial control and complete control respectively. Inland capture fisheries and aquaculture are supported by the diverse agro ecological zones providing suitable habitat for different fish species which contributed 4.18% and 1.13% of the agriculture GDP and National GDP respectively. Annual fish production of Nepal is 91832 metric tons with the contribution of 70832 metric tons from aquaculture and 21000 metric tons from the inland capture fisheries, indicating per capita fish production 3.11 kg only. The pond number, water surface area and production of fish show a slow and gradual increase from the 1998 then there seems to be rapid increase from aquaculture, while capture fisheries has been relatively stable or gradually decreasing. Different types of farming practices contributed in the aquaculture are fish farming in ponds, cages and pens, wetlands, rice fields and raceways. Fish farming in the ponds is the major contributor which alone generated 88.55% (62725 mt) of the total aquaculture production with productivity of 4.92 mt/ha. The Southern region of the country contributes most of the fish production. The total number of households involved in fish farming is 54,237 with the total of 143,241 people employed in this sector. There are 421354 people engaged in capture fisheries.

The Nepalese fishes belong to 15 orders, 40 families and 120 genera. Carps of the order Cypriniformes are the major fishes cultivated in Nepal. These includes Indian Major Carps; Rohu (Labeorohita), Mrigal (Cirrhinamrigala), and Chinese Major carps; Grass carp (*Ctenopharyngodonidella*), Silver carp (*Hypophthalmichthys molitrix*) and Bighead carp (*Hypophthalmichthys nobilis*). Two varieties of Common carp; Scale carp (*Cyprinus carpio* var. *communis*) and Mirror carp (*Cyprinus carpio* var. *specularis*) are cultivated also. Among the exotic catfishes Pangas (*Pangasianodonhypophthalmichthys*) and African catfish (*Clariasgariepinus*) are cultivated. The exotic Rainbow trout (*Oncorhynchus mykiss*) is cultivating to some extent. The carps are the major contributor which alone covered 99.4% of the total aquaculture production while trout farming contribute 0.6% only. Aquaculture has emerged as one of the fastest growing food production sub-sectors under agriculture in Nepal. Because of Covid-19 pandemic, this sector, like any other industry anywhere in the world, is severely affected. Several fish shops which sell live fish in all the province were directly affected which causes fish market disruption with high risk of collapse. Some fresh and live fish shops are in operation with minimal supply of fish product. There was negative impact on consumer's perception about the consumption of fish and fish products also. There is urgent need to maintain the short supply chain of fishes and fish products through proper healthy management system which make availability of fishes through home delivery network and sustainability of aquaculture program in the country.

REGULATION OF GROWTH, ION HOMEOSTASIS, PHOTOSYNTHESIS AND MITIGATION OF SALT-INDUCED OXIDATIVE STRESS IN MANGROVE SPECIES, *KANDELIA OBOVATA*: INSIGHT INTO THE ROLE OF NITRIC OXIDE

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We investigated the role of nitric oxide (NO) in regulating ion accumulation, improving growth and photosynthetic parameters and in reduction of oxidative stress in 2-month-old *Kandeliaobovata* seedlings grown under 1.5 and 3.0% NaCl solution for further 2 months. To observe the role of NO, 100 μ M sodium nitroprusside (SNP) was used as NO donor, while same dose of Hemoglobin (Hb) and N-nitro-L-arginine methyl ester hydrochloride (L-NAME) were used as NO scavenger and NO synthase (NOS) inhibitor, respectively. The results showed that 1.5% salinity did not affect the seedling growth but 3.0% salt decreased root length and shoot length. Both salt concentrations markedly increased the Na⁺ content but decreased the K⁺ and therefore the ratio of K⁺/Na⁺ decreased. The content of Ca²⁺ and Mg⁺ decreased only at 3.0% salinity. Low (1.5% NaCl) salinity did not show any negative effect on photosynthetic parameters, rather it improved some parameters compared to control. Higher salinity (3.0%) decreased chlorophyll content (SPAD value), net photosynthetic rate (P_n), stomatal conductance (g_s), internal CO₂ concentration (C_i), maximum quantum yield of PSII (F_v/F_m), photochemical quenching (qP), the actual quantum efficiency of PSII (Φ PSII), Non-photochemical quenching (NPQ) and electronic transport ratio (ETR) also. Salt stress also decreased transpiration and water use efficiency and increased a couple of oxidative stress markers i.e. lipid peroxidation and H₂O₂ content where results were prominent only at 3.0% NaCl. Exogenous NO had little effect in improving such photosynthetic parameters and decreasing oxidative stress. However, specific scavenger and NOS inhibitor clearly reversed these effects that indicated that endogenous NO has an obvious role in enhancing photosynthesis and maintaining antioxidant defense in mangroves.

HEAT UNIT BASED CROP COEFFICIENT MODEL FOR CLIMATE STRESS MANAGEMENT

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Crop evapotranspiration is estimated from crop coefficient curves for water balance irrigation scheduling, which reflect the changing rates of crop water use over the growing season. Temperature is usually a better predictor of the rate of development of crops and other organisms than calendar time. Because there is variation in crop development rates between locations and years, heat units (thermal) based indexes are used to relate crop coefficient curves more directly to phenological development. Plants have a definite temperature requirement to attain phenological stages and it also influences yield of crop (Bishnoi *et al.*, 1995). Growing degree-days (GDD), which is an index calculated using temperature data, is often used to estimate the time needed for a crop or other organisms to reach maturity or to reach a certain stage of development (Parthasarathiet *al.*, 2013; Paparrizos and Matzarakis, 2017). Growing degree days (GDD) is a useful climatic impact indicator as it provides indicative information to users to manage climate risks and opportunities. Cumulative growing degree day is commonly used heat unit (thermal) based index which influences crop growth by directly affecting evapotranspiration, photosynthesis and plant transpiration. Thus, keeping in view potential impact of climate change, a study was conducted to obtain growing degree days (GDD) requirement and to derive heat unit (thermal) based crop coefficient equations of mustard (*Brassica juncea* L.) and lentil (*Lens culinaris* L.) as a function of cumulative growing degree days (CGDD).

The study was undertaken at the Water Management Research Farm of the then Rajendra Agricultural University, Bihar, Pusa during the Rabi season. The experiment was laid out with five replications in plot size 5m x 3m each in which mustard (Varuna) and lentil (BR-25) crops were raised with full agronomical management. The crops were sown on November 14 and harvested on March 20 and March 28, respectively. Crop coefficient values were calculated as ratio of crop evapotranspiration and reference evapotranspiration in which crop evapotranspiration for different periods of the growing season were determined using root zone water balance technique whereas reference evapotranspiration was estimated as the product of pan evaporation and appropriate values of pan coefficient for the period concerned. Growing degree day (GDD) was estimated on daily basis as difference of mean temperature and base temperature (Morrison *et al.*, 1989) using base temperature (T_{Base}) of 5°C and upper threshold temperature of 30 °C because most plants and insects do not grow any faster below base temperature and above upper threshold temperature. Daily growing degree days (GDD) were accumulated for the concerned period to obtain the cumulative growing degree days (CGDD) then crop coefficient values were plotted with respect to cumulative growing degree days (CGDD) to derive a heat unit (thermal) based crop coefficient curve to mitigate climatic variability and keeping in view the scatter, polynomial function of the following form was fitted to the data: $K_c = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + \dots$

Where, K_c = Crop coefficient value during the period, $a_0, a_1, a_2, a_3, \dots$ = Regression coefficients, and x = Cumulative growing degree days (CGDD) in °C- day

Weather based parameters like heat use efficiency (HUE) was calculated as ratio of grain yield and cumulative growing degree days (Amrawat *et al.*, 2013) whereas photo thermal index (PTI) was calculated as ratio of cumulative growing degree days and growth days (Singh *et al.*, 2014):

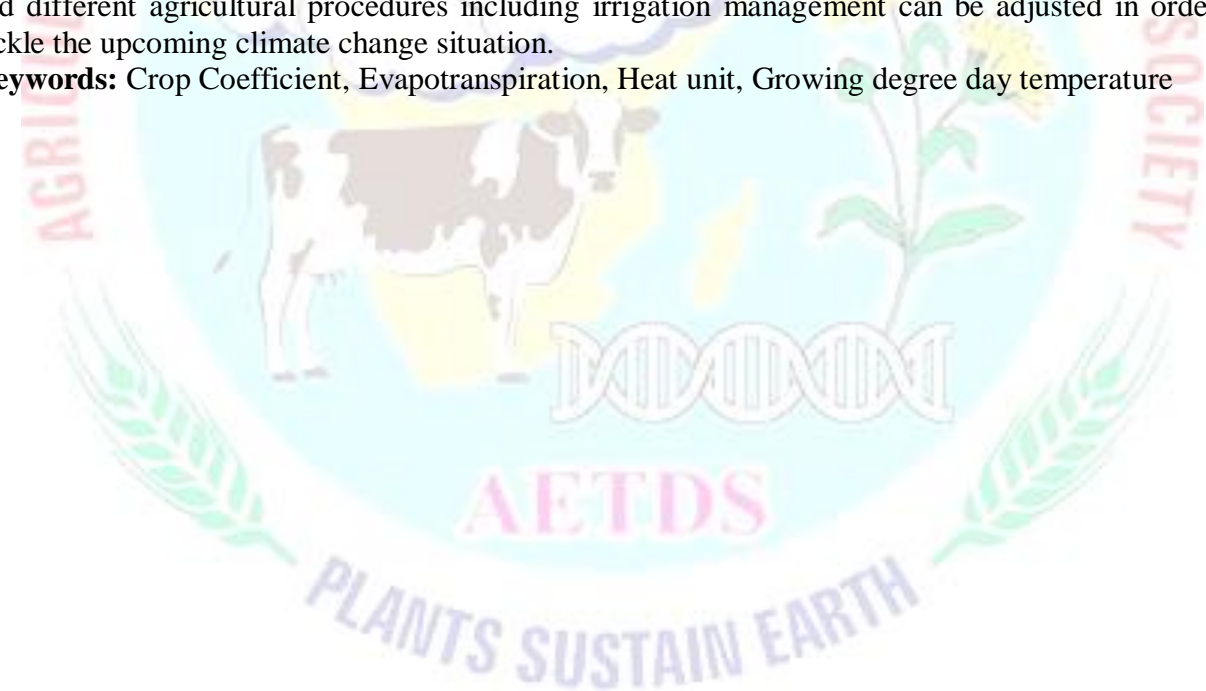
Results depicted that mustard and lentil, respectively achieved growing degree days (GDD) of 1648.0 °C-day and 1791.0 °C-day during growing season. In present study, crop coefficient (K_c) values of mustard and lentil were plotted against cumulative growing degree days (CGDD) in which fourth and third order polynomial equation for the respective crops was found best fit. Bandyopadhyay *et al.* (2005), Hunsker (1999) and Sammis *et al.* (1985) found third, fifth and third order polynomial function, respectively as best fit. The polynomial equation relating crop coefficient values (K_c) and cumulative growing degree days (°C) were derived as follows:

Mustard, $K_c = 2.57 \times 10^{-12} x^4 - 8.57 \times 10^{-9} x^3 + 8.03 \times 10^{-6} x^2 - 1.30 \times 10^{-3} x + 0.13$, $R^2=0.978$

Lentil, $K_c = 2.00 \times 10^{-10} x^3 - 2.00 \times 10^{-6} x^2 + 2.00 \times 10^{-3} x - 0.360$, $R^2=0.843$,

Where, K_c = Crop coefficient and x = Cumulative growing degree days (°C-day). Using the above equations, crop coefficient value for any cumulative growing degree days can be estimated. It is inferred from the results that heat use efficiency (HUE) of mustard (0.89 Kg/ha / °C- day) shown slightly greater value than that of lentil (0.51 Kg/ha / °C- day) whereas photo thermal index of mustard (12.97 °C- day /day) was less than lentil (13.26 °C- day /day). The study will be helpful in estimation of crop evapotranspiration and for deciding irrigation scheduling of these crops on the basis of temperature data. Accumulated GDD had less variability than calendar days in predicting the time duration to harvest the crops so effect of climate variability on these crops can be mitigated and different agricultural procedures including irrigation management can be adjusted in order to tackle the upcoming climate change situation.

Keywords: Crop Coefficient, Evapotranspiration, Heat unit, Growing degree day temperature



CLIMATE – SMART SOIL FERTILITY MANAGEMENT IN PERENNIAL FRUITS

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Soil is an environmental medium, playing crucial role in global C cycle (soil C pool as the second biggest carbon pool), mainly through changes in soil fertility. Soil is, therefore, viewed as a part of climate change problem, but it can be a better part of the solution. Besides elevated CO₂, changes in rainfall pattern and increase in average temperatures brought about by climate change with inflict over-riding effects on soil fertility changes vis-à-vis crop performance. Synergism between the effect of CO₂ and nutrients is stronger under no water limiting conditions. However, such short term changes in fertility dynamics do not portray the long term effect either on soil fertility or on production responses, unless supported by defined analogues of soil and climate. Different fruit crops sequestering 24 – 109 tons CO₂/ ha display their ability to moderate climate change-related issues on one hand, and elevate the crop fertilising ability for improved plant nutrition, besides water-use-efficiency, on the other hand. Therefore, response of different fruit crops under elevated CO₂ condition is a function of nutrition status of the crop. Our studies demonstrated the maximum nutrient demand at fruit set stage (March-April for winter crop and August-September for summer crop under sub-humid tropical climate of central India). As per crop ontogeny unless there is some mitigation strategy available. Of late, certain citrus growing pockets of central India irrespective of orchard nutrient status (possibility of disturbed K metabolism), exhibited abnormal fruit growth (greater growth along equatorial than radial axis), the exact cause and effect relation still remains to be established. A large difference in fertility of two sites (Ustorthent versus Haplustert) indicated by a much greater increase in yield response at the low fertility soil site (Ustorthent) than the high fertility soil site (Haplustert), when added nutrient augmented to the same optimal fertility. But with climate change, such responses will be caused by nutrient limitation that can develop in poor fertility sites having shallow rooting depth. The recommended dose of fertilizers (RDF) worked out in 1990 – 91 is no longer effective now (2010 - 2015), due to rise in average temperature by 1.5 – 2.0 °C during fruit set stage, necessitated addition of 25% more K to moderate such temperature stress in citrus. How does RDF behave in the long run in different crops?

Better responsiveness of soil microbial biomass over chemically available nutrient pool to nutrient input, has led to renewed interest in measuring the quantum of nutrients held microbially. Long term data accrued on response of organic manuring versus inorganic fertilizers demonstrated that important soil quality indices like soil microbial diversity, soil microbial biomass nutrient (C_{mic}, P_{mic}, and N_{mic}) and organic carbon partitioning displayed significant changes, but without much difference in quantum of fruit yield. The efficacy of microbial consortium (*Azotobacter chroococcum*, *Bacillus mycoides*, *Bacillus polymyxa*, *Pseudomonas fluorescence* and *Trichoderma harzianum*) was tested successfully in both nurseries as well as well grown-up orchards as best management practice to cut down the rate of CO₂ release compared to inorganic fertilizers for storing larger proportion of plant-derived C in long term pools in the soil and reducing the exposure of such stored C to lesser decomposition, in addition to better post-harvest shelf life of citrus and other fruits. The other approaches involving multiple microbial inoculation alongwith enrichment of organic manures through inorganic fertilizers known as substrate have further been highlighted to provide an understanding of mechanism involved in C stabilization in soils for regulating soil C sequestration and associated nutrient dynamics under INM-based production system in perennial fruit crops. Crop-based adaptation strategies are needed keeping in view the nature of crop, its

sensitivity level and the agro-pedological setup. Simultaneously, keeping an eye on carbon sink potential of different fruit crops vis-à-vis annual field crops will further aid in developing a blue print for redressal of climate change related issues.

TOLERANCE OF SORGHUM (*Sorghum Bicolour* L.Moench) SEEDLINGS UNDER SALINE STRESS IS ASSOCIATED WITH HIGHER CATALASE AND GLYOXALASES

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Salinity mediated oxidative tolerance mechanism was studied in four sorghum lines; BLS-2864 and BSL-29468 as relatively tolerant whereas BS-1 and BSL-9745 as relatively susceptible to insight of the mechanism. Ten days old seedlings grown in rock media were transferred into hydroponic system containing three levels of salinity (0, 8 and 12 dSm⁻¹) for 43 days month. Important stress attributes like reactive oxygen species (ROS) and methylglyoxal (MG) detoxification systems as well as ion homeostasis were studied in fully expanded leaves. Both ROS [O₂⁻ (superoxide) and H₂O₂] and MG were higher in saline susceptible lines. Conversely, K⁺/Na⁺ was higher in tolerant genotypes, particularly at 12 dSm⁻¹. Although changes of SOD activity were apparently similar in all genotypes, CAT activity was strongly inhibited by salinity in susceptible genotypes suggesting the importance of CAT in H₂O₂ metabolism in tolerant genotypes. On the other hand, GPX activity played equal role in both types of genotypes. Notably, higher MG in susceptible genotypes was due to comparatively lower Glyoxalase-I (Gly-I) and Glyoxalase-II (Gly-II) activities. Therefore, CAT and glyoxalases played important role in conferring tolerance in the survival of tolerant genotypes of sorghum.

Keywords: Salinity; sorghum; oxidative stress; ionic balance, isozymes, ROS, methylglyoxal

IMPACT OF THE STORAGE TEMPERATURE OF CERTAIN FOODSTUFFS OF ANIMAL ORIGIN ON CONSUMER HEALTH

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A food of animal origin is a food produced by animals such as cattle, sheep, goats, poultry, fish, etc. It is an important source of nutrients for humans (proteins, lipids, carbohydrates, etc.). It requires well-defined temperatures for their preservation, + 6 ° C for raw milk, pasteurized milk and chilled eggs in shells, + 3 ° C for offal and cut meats from the butcher's shop and meats packaged in consumer units and + 2 ° C for fresh seafood, especially fish, crustaceans, molluscs.

Failure to respect these little temperatures leads to harmful effects on the health of the consumer, especially from certain values, bacteria can develop and produce enterotoxins such as *Staphylococcus aureus*. At the same time, the evaluation of the temperature of food storage at points of sale is an essential factor in preventing collective food poisoning when food is consumed without any heat treatment, above all, with changes in the food practices of Algerians and a development of

the fast food sector. It will be very useful to carry out a program to improve the food ration in all the farms of the country; this will help to improve the quality and quantity of the foodstuff but would also improve the independence of Algeria vis-à-vis abroad in terms of imports of certain foods, thus providing benefits for all the country's economy.

Key Words: Human health, bacteria, food poisoning, heat treatment.

IMPROVEMENT OF SOIL PHYSICAL AND CHEMICAL PROPERTIES WITH APPLIED SOME ORGANIC AND SYNTHETIC SOIL CONDITIONER UNDER DIFFERENT NITROGEN RATES ON WHEAT PRODUCTION

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The main problems of sandy soil are its inability to hold on to nutrients, its fast drainage, its lack of soil structure and its small buffering capacity. It cannot hold on to nutrients because it has little or no clay and organic matter. Therefore, the objective of this study was decided the effect of combined application some synthetic soil conditioners with two forms of humic acids (HA) as organic acids as soil conditioners in reducing nitrogen fertilizer requirements to maximizing wheat yield. Two experiments were designed in a split-split plot design with three replicates. The main plots included three forms of organic acids as soil conditioners (control, potassium humate (HK) and calcium humate (HCa)), sub-plot were three synthetic soil conditioners (without, poly vinyl alcohol (PVA) and bitumen (B)), as well as the sub-sub plots represented three levels of nitrogen fertilizer (50, 75 and 100% from recommended dose of application). The common agricultural practices for growing wheat according to the recommendations of Ministry of Agriculture were followed.

Obtained results revealed that the application of humic acids form either HK or HCa in combination with PVA or bitumen emulsion under different application rates of nitrogen fertilizers were enhanced wheat plant productivity (yield, straw and grain dry matter kg/fed) along with nutritional status (N, P and K uptake), nitrogen harvest index (NHI) and nitrogen uptake used efficiency (NPE) as compared to control treatment. The superior one is HCa in combination with bitumen emulsion at 75% N application. Moreover, soil fertility was improved by adding soil conditioners in different forms with/without nitrogen fertilizers as compared to control treatment i.e EC values, OM and available NPK were significantly increased in all treatments applied; the maximum increased was observed with HCa combination with bitumen emulsion at 75% from nitrogen dose. Also, the same trend was observed with dry stable aggregates and total porosity of sandy soil at two seasons respectively in contrast to bulk density where all values were decreased.

In conclusion, can be clarified that the applied of humic materials either HK or HCa was increasing soil fertility which reflected on wheat plant productivity but it was more efficiency when combination with synthetic polymers especially bitumen emulsion and can be save about 25% from nitrogen fertilizer applied.

Keyword: Synthetic polymers, humic acids, nitrogen fertilizers, sandy soil and wheat plant

LEGAL INITIATIVES FOR THE EFFECTIVE ENVIRONMENTAL GOVERNANCE AND FOR THE SUSTENANCE OF SUSTAINABLE DEVELOPMENT BY THE SUSTAINED JUDICIARY IN INDIA

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Though Sustainable Development word has come in to existence from Rio Declaration (1992). But if any one could trace the history of the Indian culture, whatever the practices we were doing from time immemorial were all of towards Sustainable Development. But most unfortunately due to the introduction of western culture in to our system it has slowly changed into consumerist culture. From the repair to remove and replace to use and throw culture. Even though the Sustainable Development principle has come into existence since Rio Declaration (1992), strictly and judicially speaking it was in the form of soft law only, which is judicially non enforceable and non obligatory on the part of signatories. It is needless to say India was also partner for the Declaration. But still the soft law was given hard law status in India by our Hon Supreme Court in its land mark judgement in the Vellore Citizen Welfare Forum vs Union of India case in the year 1996. For the effective Environmental Management three “E” s are essential vide Engineering, Education and Enforcement. In Engineering point of view to attain the sustainable development we have to have a comprehensive look and control of all the sources and types of pollution through technological input and ways and means. It is highly imperative to blend the scientific principles into the engineering and develop technology to control and manage the pollution both at the source and end pipe treatment with clean development mechanism where it is possible. The second “E” is Education –namely creating an awareness and sensitizing the people the importance of pollution control, changing the life style and behaviour of the people and practice more ecofriendly methods. Infact Hon Supreme Court in one of its land mark judgements made Environmental Education as one of the compulsory paper in the college and University curriculum irrespective of the branch of study, with same syllabus throughout the length and breath of the country. Finally with reference to third “E” namely Enforcement here the laws play good amount of role in managing and controlling the Environmental pollution and Environmental Protection. Laws are the tools in the hands of the enforcement agencies to control and combat the pollution. Again for the purpose of enacting the laws the Constitution has give room for the legislature. In this connection it can be very proudly said that India is one among the few countries in the world where the Environmental Protection is given the Constitutional status. We have enacted a plethora of Environmental Legislations in the last two decades in addition to the Indian Penal Code for the effective environmental management. Apart from this Legislature, Executive, the third arm and pillar of the democracy namely Judiciary also played a very active role and paved the way for the emergence of environmental Jurisprudence. In my paper, I am going to discuss the how far the Sustainable Development has been given a hard law status by the Judiciary and more so the higher judiciary innovatively interpreting the Constitution elevated the Environmental Right in to a Constitutional Right from the ordinary simple public nuisance under the IPC. Apart from that the judiciary also ingrained certain principles and doctrines into our Environmental Jurisprudence. In spite of all these we could not able to achieve the requisite or expected target, why. Apart from this the global concern for environmental crisis have led to the evolution and remarkable growth of international environmental Law also

The analysis has been made under the following headings:

International Web Conference

Perspective on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020)

The different principles of International Environmental Law
The Legal Status of General International Environmental Principles.
The various concepts and Principles of Sustainable Development
Right to Development - Human Right
Role of Human Rights Law in the Protection of Environment and
the advantages and disadvantages of Human Rights Approach
Treaties concerned with Third Generation Rights
Advantages and Disadvantages of Human rights Approach
The International Law and State Courts
International Law and the Indian Constitutional Scheme.
International Law and the distribution of Legislative power
International Law and the Constitutional Duty
International Law and Indian Courts

The Judicial adoption of international environmental law into domestic law in India has not been done overnight rather it has been gradual. In order to understand the Judicial process of such adoption Finally a blend of technological solution with Economic, ecological and legal regime together with political will, public participation and professional ethics, alone can solve the Environmental problems effectively and for the sustenance AND EFFECTIVE MANAGEMENT of Sustainable Development.



**ENHANCING FARMERS' INCOME THROUGH MILLETS CROPPING SYSTEM IN
NOTHERN TRANSITIONAL ZONE"**

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Indian population is dependent on agriculture which governs national economy, also food and nutritional security of the country and accounts for approximately one-fifth of the total gross domestic product (GDP). With increasing population, agriculture has prolonged scope for sustainable development to feed the mouth of vast population and livelihood support for rural population. Rainfed agriculture, which is totally rain dependent, accounts for 55.3% (about 78 m ha) of the net cultivated area in India and supports 40% of the human and 60% of the livestock population. To achieve the target of doubling farmers' income by 2022, the study has suggested a practical measure of increasing focus on production of millets in the country. For increasing the productivity of millets and consequently income of farmers, the study has looked into the impact of reduction in yield gap and inclusion of fallow and waste lands under cultivation. Small millets are more nutritious and have a lower glycemic index than rice and wheat, but factors like lack of improved varieties, agronomical packages and practices as well as unorganized seed system are constraining production and productivity. Therefore, the present study was carried out to know the yield gaps between improved practices and farmers' practices under Frontline demonstration on little millet and foxtail millet were carried out by ICAR-Krishi Vigyan Kendra, Hanumanamatti, Haveri district of North Karnataka to assess the impact of adopting improved package of practices over farmers' practice on the yield and economics of millets during kharif season from 2013 to 2019. Higher yield of little millet was recorded under improved practices which were ranged from 13.60 to 18.00 q. ha⁻¹ which was 18.70 to 28.57 per cent higher than farmers' practice. Similar trend was noticed in foxtail millet which was showed 14.50 to 21.00 per cent higher grain yield over farmers' practice during all the five years. The average technological gap for grain yield in little millet and foxtail millet ranged from 7.00 to 15.00 q. ha⁻¹ and 4.00 to 12.30 q. ha⁻¹, respectively over the five years. Highest gross return of Rs. 43,484 ha⁻¹, Rs. 35,656 ha⁻¹ of net return with highest B:C ratio of 5.56 were obtained across the five years for millets under improved practices as compared to farmers' practice.

BHUNGRU (A UNIQUE TECHNOLOGY TO AUGMENT GROUNDWATER IN DRY ZONES)

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BACKGROUND OF BHUNGRU

Bhungru (भुंगरूः) is a unique scientific technology for storing rain water into subsurface zone of earth for augmentation of groundwater & return it back in lean periods for domestic, agricultural & industrial uses. For its uniqueness JHARKHAND GOVERNMENT has chosen it under JHARKHAND INNOVATIVE FORUM & NITI AAYOG has recognized it under ‘ASPIRATIONAL DISTRICTS, UNLOCKING POTENTIALS’. It has also been selected as a ‘start up’ by Jharkhand government as well as India government.

The word ‘BHUNGRU’ (भुंगरूः) is derived from BHUNGRU MAHADEV or BHUNGRU DEVTA, an ancient God of Adivashis. BHUNGRU MAHADEV is another name of LORD ‘SHIVA’.

According to Hindu Mythology, Goddess River Ganga originates from matted hair of LORD ‘SHIVA’ and flows through Indo-Gangetic plain of India to Bay of Bengal. Pure and holy water of river Ganga brings prosperity to millions of Indians who live along its course and depends on it for their daily need.

In the same way, fresh, clear and light water from ‘BHUNGRU’ (भुंगरूः) also brings prosperity to people living in its surroundings.

It is well tested environment friendly disaster alleviation technology that purifies, injects and reserves rain water, excess farm water and storm water below the surface of earth for lean period uses.

Use of Bhungru in Agriculture

The demand of water resources is increasing by the day due to rapid urbanization, increase in population, agriculture, depleting forest cover and infrastructure growth. An uncertain monsoon, lack of adequate irrigation facilities and over exploitation of surface/ground water have only compounded the problem and the situation ahead can only be described as alarming.

Approximately 70 per cent of global freshwater consumption is used in the agricultural sector, The FAO (Food and Agriculture Organization) forecasts that by 2050 global water requirements for agriculture will increase by 50 per cent to meet the increased food demands of a growing population. Global freshwater is becoming increasingly scarce, due to improper management, indiscriminate use and a changing climate.

The Bhungru (भुंगरूः) plays a significant role in agriculture with ensuring adequate amount of water during lean period. Each unit of Bhungru ensures irrigation water to 15- 20 acres of farm lands for 6 months in a year, starting from one to five million liters of stored water depending upon Geo-hydrological condition of particular place.

This technology provide two dimensional supports to farmers, first, saves standing crops in monsoon with de-flooding the farm land, second, ensure enough irrigation water for Rabi crops.

Many a times delayed or insufficient rain as well as critical groundwater conditions results in High crop failures with big financial losses to farmers and these situations several times compel farmers

either to commit suicide or to migrate to cities and towns as a daily laborers. Water from “Bhungru” (ভূগরু:) helps enormously in reducing migration and suicides of farmers.

OTHER ADVANTAGES FROM BHUNGRU

Groundwater is not directly exposed to evaporation and pollution.

Reducing groundwater salinity in agricultural areas.

Easier access to water when it is nearer to the surface—reduces pumping costs.

Reducing land subsidence caused by high pumping rates.

Recharge methods are environmentally attractive, particularly in arid regions.

It reduces flood hazards.

Recharge can increase the sustainable water yield of an aquifer significantly.

Mitigates effects of drought.

Reduces soil erosion.

Preventing seawater intrusion by creating freshwater barriers.

It reduces hardness of groundwater.

Keywords:- BHUNGRU , Boon for farmers, A unique solution for groundwater conservation.

EFFECT OF PROCESSING AND DRYING ON QUALITY EVALUATION OF READY TO COOK JACKFRUIT

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The current study was carried out with the objective of processing and developing ready to cook (RTC) jackfruit to evaluate their nutritional and sensory quality. In this study, green tender jack fruits were harvested from 60 to 70 days after synthesis (DAS). Then the fruits were washed, peeled and sliced. The slices were treated with different treatments viz. control (T₁), dipping into 0.5% salt solution (T₂), 0.2% citric acid solution (T₃), 1000 ppm potassium metabisulfite (KMS) (T₄), 1000 ppm KMS + 0.5% salt (T₅), 1000 ppm KMS + 0.2% citric acid (T₆), 0.5% salt + 0.2% citric acid (T₇) and 1000 ppm KMS+ 0.2% citric acid+ 0.5% salt (T₈). Then the treated sliced was steam blanched for 8 min. The roasted beef spices were mixed with blanched slices owing to preparation of RTC. Then the roasted slices were dried at 50°C, 60°C and 70°C temperature. Results revealed that RTC dried at 50°C, 60°C and 70°C temperature took 72 hrs, 48 hrs and 36 hrs respectively. Low KMS residue was observed with increasing blanching time and drying temperature. The physico-chemical characteristics (vitamin-C, β-carotene and energy), thiamin, phytochemical and antioxidant activities were retained more by the 60°C temperature. Color, flavor, texture, astringency, bitterness, taste and appearance were evaluated by sensory panel using a 9-point hedonic scale. The highest score was obtained by the RTC dried at 60°C. The moisture content was found to be 5.70 %. The marketable life of the RTC jackfruit could be extended 6 months more. Cost of the product was found to be Tk. 25/kg. However, the findings suggest that green tender jackfruit treated with 1000 ppm KMS, blanched for 8 min and dried at 60°C is a quick and healthy option in terms of good marketable life, nutritional and sensory quality attributes.

Keywords: Jackfruit, RTC, physico-chemical properties, color, sensory attributes

ROLE OF COFFEE IN NATURAL RESOURCE MANAGEMENT AND ITS CONSERVATION IN ANDHRA PRADESH

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Coffee is one of the most commercialised food products and widely consumed beverages. All over the world, more than 400 billion cups of coffee are consumed every year. In India, coffee is emerging as the most popular beverage among the youths and urban population. Coffee was introduced as a plantation crop in agency areas of Andhra Pradesh during 1960s to wean away the tribal farmers from shifting cultivation. Since then, the planted area under coffee in Andhra Pradesh has steadily increased and presently more than 80000 ha is under coffee providing employment to more than 1,40,000 families. Coffee cultivation helps in conservation of forest and native bio diversity. The leaf litter from the shade trees retains the carbon in soil and helps in recycling of nutrients. The coffee ecosystem helps to reduce soil erosion up to 37% in hilly terrain. The organically grown Arabica coffee from Andhra Pradesh has high demand both in national and international market. So, there is tremendous scope for sustainable development in the agency areas of Andhra Pradesh through production of high value speciality coffee like shade grown coffee, high altitude coffee, organic coffee and through coffee trade. Owing to these positive aspects, the coffee cultivation in these areas will certainly conserve the fragile eco system, conserve natural resources and will pave the path for sustainable development in terms of livelihood of the tribal's and also various stakeholders involved in coffee.

Key words: Shade grown coffee, Conservation of forests, Bio diversity, and Sustainable development.

CHANGING SCENARIO OF AGRICULTURE INDUSTRY IN RELATION TO FOOD SECURITY, HEALTH AND INCOME GENERATION

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There is increased interest in urban agriculture in recent years that has emerged for many reasons. Some are concerned about food security, sovereignty, and impacts of agriculture on the environment. Some see new business opportunities for urban food operations, utilizing new technologies such as hydroponics and high-efficiency lighting systems. Others see urban farms and community gardens as mechanisms for community building, or as means of improving the nutritional security of vulnerable populations. In the Global Scenario urban agriculture has long been a significant component of food systems. We consider both historical and geographic perspectives of urban agriculture and also consider urban agriculture in terms of its effects on environmental, economic, and social sustainability. Urban farms and community gardens can have both positive and negative environmental impacts. They can, for example, either reduce or increase energy consumption, improve water infiltration, and beautify neighborhoods, or produce odors and contaminate water. The most significant environmental issue for urban farms, however, is food safety. Land in the urban environment can be contaminated with many pollutants, including lead and a range of toxic hydrocarbons, and water may be contaminated with human pathogens. Urban

farms are viewed by many to deliver economic and social benefits, although some people see them as an inappropriate land use and a hindrance to progress. We consider urban agriculture to be broadly progressive and capable of delivering a suite of environmental, economic, and social benefits. We urge city planners and urban farm managers to be diligent in developing urban agriculture systems that deliver the greatest possible benefits while mitigating risks.

Urban agriculture has been defined in slightly different ways by various authors (Mougeot 2005; Cabannes 2012). We do not feel the need to clutter the literature with yet another definition, and our review will be inclusive rather than exclusive, considering any form of food production in downtown, peri-urban, suburban, ex-urban and urban fringe areas of small towns and large cities as pertinent to this discussion, clarifying differences as necessary throughout the paper.

Urban agriculture represents many different things to different people in different places. The value of raising food in urban areas must be made in the context of the rapid and potentially overwhelming economic, environmental, and social changes that we are experiencing. First, urban food production must be considered in the context of a rapidly growing and urbanizing global population. Meanwhile, there are clear threats to food production from the depletion of fresh-water resources, the degradation and erosion of soils, threatening temperature and precipitation changes in many agricultural regions, limitations to the availability of cheap fertilizers and increasing costs of energy, especially the liquid fuels upon which transportation and food production systems are highly dependent. The combination of increasing population pressures and the risks of productivity failures bring into sharp focus the need to critically analyze all systems that might improve or worsen our capacity to maintain stable, well-fed populations. Interest in opportunities for food production in urban environments has blossomed in the last few decades as a result of a range of changing social and political perspectives, economic and environmental realities and perspectives, and technical developments. What has emerged is a vibrant and remarkably diverse urban agricultural scene for recreation, community building, profit, or subsistence, including backyard, community, and school gardens, the cultivation of a wide range of crops, indoors, and outdoors, and small commercial farms of many kinds.

The distinction of whether an agricultural operation was urban or rural was less relevant when farming operations and cities were smaller and more people lived in small towns and villages—and the distinction is less important today in parts of the world where that is still true. For the vast majority of our history, food was produced in complex, mixed-use agricultural areas with mixed-use farms. Rapid change came to both the city and the countryside as the Industrial Revolution drew large numbers of people to urban centers, which subsequently became much larger, more densely populated, and polluted.

The desire by citizens to produce food free of pesticides and to use community gardens as a means of revitalizing unused city spaces has picked up followers who also believe in reducing food miles with local agriculture. Urban farms may exhibit practices that encourage sound or unsound soil and water management, sustainable or unsustainable economic models, and progressive or regressive social impacts. Cities, and their slums and suburbs, have grown considerably, concreted over much more cultivable land, and the stakes for future emergency food programs could be much higher in a world with more limited natural resources and much larger populations.

Urban agriculture is carried out for four main reasons: subsistence, economics, recreation, and community building. From a global perspective, urban agriculture appears to be much more important in developing countries whereas people in the poorest nations tend to grow food primarily for subsistence and sale.

Now if we have to consider the case of this severe Pandemic in general and its impact on agriculture may be the present and future of agriculture and farming for sustainability and food security then we need to look into these questions ;

Firstly could consumers change demands regarding food security and quality? If so, what could be the new pressures on crop protection? Secondly could the world change the priorities? Depending on continent, region, type of agricultural farming systems and technologies? Will there be a shift on research and development. May be Brainstorming of ideas or funding agenda for crop production?

The impacts will probably differ among different societies and their culture, demography, socioeconomic structure, population density, living standards, etc., There will probably be direct impacts that are easier to identify such as social behavior, sanitation scenario market strategies ,etc. and what about Indirect effects that are more difficult to identify. With respect to the agriculture industry, what could be the effects in general terms and maybe crop protection in particular. The reverse migration of labor is having a strong yet different impact across different regions. Agricultural operations in the near urban regions will suffer however the rural regions will see an excess supply of labor bringing up the new challenges For this it is worth that one should revisit the policies and bring about few relevant changes for further development in the sector.

Only after the success of the green revolution the agricultural sector has gained a respectable place as an agent of economic development.

New and innovative agricultural technologies has helped to a greater extent because these technologies are input-intensive. Agro-processing industry has now emerged as a major economic activity globally and in India. The role of these industry and sector of agricultural growth is in uplifting people of rural areas. The labor force has to be substitute for the probably reduced input application in agriculture to help maintain the production level, resulting in increased factor share of labor in the agricultural sector. Maintaining food security both at household and intra-household levels will be challenging with increase in population and the presence of additional members without income and contribution to food production could worsen the nutritional security of population in both Urban and rural areas.

Therefore to help overcome these challenges particularly after the crisis of pandemic agriculture policies should promote the processing industries, urban farming nutritional crop production, food safety and quality etc., and alongside of these the education of growers and consumers both towards more diversified production , marketing and consumption so as to face the new challenges of food security and health.

EVALUATION OF CERTAIN BOTANICALS AS SEED PROTECTANTS AGAINST PULSE BEETLE, *Callosobruchus chinensis* (L.) ON CHICKPEA

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A laboratory experiment with six different botanicals as seed protectants against *Callosobruchus chinensis* on chickpea (*Cicer arietinum*) was carried out at $27 \pm 2^\circ\text{C}$ and 70 % RH. The study involves the use of Neem leaf powder 5g/ 100 seeds, Nimbicidin 5ml/ 100 seeds, Karanji oil 5ml/ 100 seeds, Custard apple leaf powder 5g/ 100 seeds, Castor oil 5ml/ 100 seeds and Eucalyptus oil 5ml/ 100 seeds against *C. chinensis* in chick pea. The observations recorded on percent seed

infestation, percent seed weight loss, percent fecundity and percent oviposition, where Deltamethrin (2.8 EC) 0.04ml/ 100 seeds and untreated treatment used as standard check and untreated check respectively. The results revealed that all the treatments was significantly superior then the untreated control thathave maximum insect damage (9.0%) at 30 days of storage period. Insectinfestation percent was increased in all the treatments with period increased instorage and nature of protectants. Minimum percent infestation and percent weight loss were noted in Deltamethrin (2.8 EC) 0.04ml/ 100 seeds followed by Nimbicidin 5ml/ 100 seeds and highest were in untreated control. The present study concluded that application of bio inputs were effective next to insecticides for the management of pulse beetle in chickpea.

Key words: *Callosobruchus chinensis*, botanicals, Seed infestation, fecundity, mortality

EFFECT OF DIFFERENT LEVELS OF NITROGEN AND PHOSPHORUS ON YIELD AND UPTAKE OF CALENDULA

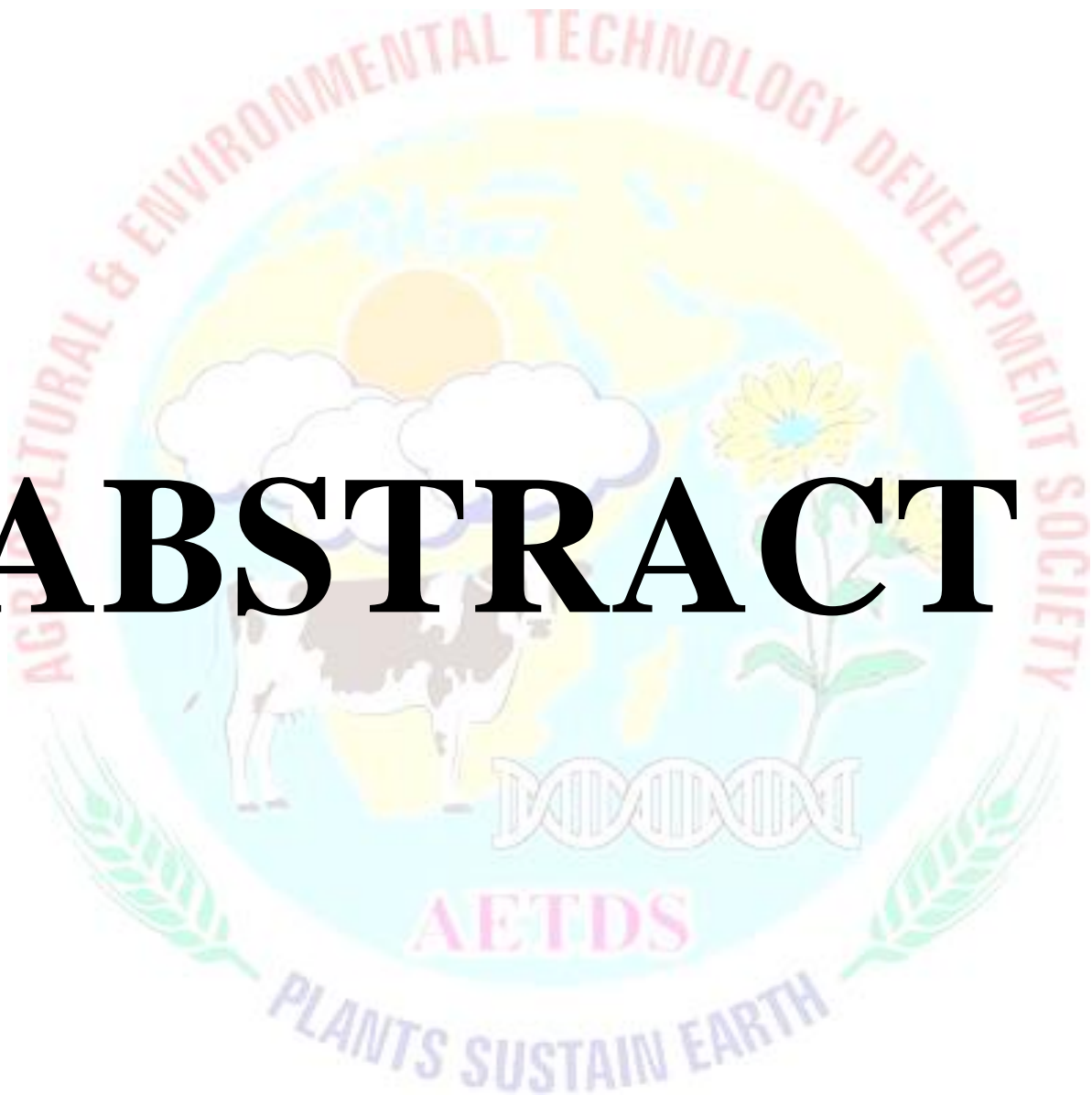
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This research was conducted to investigate the effect of graded level of N and P on yield, quality and uptake of calendula, during winter season at Horticulture Section, College of Agriculture, Nagpur. Using different levels and combination of nitrogen and phosphorus for evaluate the yield, quality and uptake of calendula. The Experiment was laid out in factorial in randomized block design with sixteen treatments (each treatment with 3 replications). The results of present investigation revealed that, application of 100 kg ha⁻¹ N and 50 kg ha⁻¹ P produced significantly maximum shelf life, vase life of flower and oil content in flower with respect to quality parameters which were at par with the results obtained with the application of 125 kg ha⁻¹ N and 75 kg ha⁻¹ P. Total uptake of nitrogen, phosphorus, potassium in flower and plant of calendula maximum in treatment combination N₃P₃i.e. 125 kg ha⁻¹ N and 75 kg ha⁻¹ P. The interaction effects revealed that, they were significant in respect to number of flowers plant⁻¹, flower yield q ha⁻¹, oil content in flower and total NPK uptake of calendula. For these parameters, the best treatment combination was 100 kg N kg ha⁻¹ + 50 P kg ha⁻¹ and 125 N kg ha⁻¹ + 75 P kg ha⁻¹.

Keyword: Calendula, Nitrogen, Phosphorus, uptake, yield

ABSTRACT



PRESENT STATUS AND FUTURE STRATEGIES OF WHEAT IMPROVEMENT UNDER COVID-19 PANDEMIC

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Wheat is the major cereal in Bangladesh next to rice. Wheat consumption is increasing every year due to changing consumer behavior as a result of urbanization, employment generation and improved socio-economic conditions at the household levels. Currently, Bangladesh needs >7.0 million tons of wheat grain annually against the domestic production of about 20% of the total requirement. As per DAE, in 2019-20 season 1.25 million ton wheat has been produced from 0.342 million ha with a record highest productivity of 3.64 t/ha. High productivity mainly results from the adoption of high yield potential varieties resistant to major foliar diseases and tolerant to terminal heat stress and improved crop management technologies by the farmers. However, high crop competition in winter is a great challenge to expand wheat production in the country. Moreover, current COVID-19 pandemic may create negative impact on the availability of wheat grain by hindering the import from international market and eventually resulting in a price hike. So, domestic wheat production needs to be increased to reduce import pressure and ensure the availability of required amount of wheat grain. Wheat production may be increased through the adoption of high yield potential variety along with best-bet agronomic practices and expansion of wheat in non-traditional areas such as southern coastal region, Char land and drought prone areas of north-west Bangladesh. Adoption of scale-appropriate machinery for conservation agriculture like zero-tillage, strip tillage, raised bed, etc. in stress prone environments will contribute to ascertain good crop establishment and improved grain yield. Consumptive use of fresh water and semi-saline water for irrigation in southern region is also important to bring huge winter fallow land under wheat cultivation. So far 34 wheat varieties have been released in Bangladesh of which 10 varieties released since 2010. Recently released wheat varieties have high yield potential (>6.0 t/ha), resistant to major foliar diseases and tolerant to high temperature. BARI Gom 33 released in 2017 is the first Wheat Blast resistant variety in this region along with high grain Zn content of 50-55 ppm. This variety is becoming popular and farmers are coming back to grow wheat again after the wheat blast epidemic occurred in 2016. Precision Phenotyping Platform has been established at Jashore for large scale germplasm screening against wheat blast through CIMMYT and ACIAR support. Two more blast resistant/tolerant varieties have been released very recently for commercial cultivation. Rapid seed multiplication and availability of quality seed of new wheat varieties are paramount for quick dissemination of these varieties to the farmers.

Key Words: High yield potential variety, Wheat consumption, Phenotyping

**COMPARATIVE STUDY ON YARN COUNT OF COTTON AND NETTLE/COTTON BLEND PRODUCED FROM OPEN END SPINNING
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Yarn characteristics extensively influence by spinning process. Open end spinning was used for yarn development. The open end spinning system is used for unconventional fibres that have structural problems and may result in coarse to medium counts. The aim of this study is to observe the effect of open end spinning process on yarn count of 100 % cotton yarn and 50:50 nettle: cotton blended yarn. The twist per inch of 11 to 10 was set to fabricate 12.14 Ne and 9.50 Ne count of yarn respectively. The effect of spinning process on the yarn count was evaluated by Fisher's least significant difference (LSD). The results exposed that yarn count of open end spinning were exhibited higher for the unconventional fibre blended yarn.

Keywords: Open End Spinning System, Unconventional Fibres, 100 % Cotton Yarn, 50:50 Nettle: Cotton Yarn

SCREENING OF SOYBEAN GENOTYPES FOR WATERLOGGING STRESS TOLERANCE AND UNDERSTANDING THE PHYSIOLOGICAL AND BIOCHEMICAL MECHANISMS

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Abiotic stress is the most detrimental factor responsible for crop yield reduction and appears to be a potential threat to global food security in coming decades. Soil waterlogging is a common abiotic stress worldwide in cultivated areas and influences the composition and productivity of soybean. Focusing that issue, an experiment was carried out at the Crop Science Laboratory of Sher-e-Bangla Agricultural University, during the kharif-II season of 2019 to screen out the waterlogging tolerance and yield performances of selected soybean genotypes. The experiment was designed in a randomized completely block design (RCBD) with three replications. The Experiment consisted of 2 treatments (control and waterlogging) and 12 genotypes (Sohag, BARI Soybean-5, Binasoybean-1, Binasoybean-2, Binasoybean-3, Binasoybean-5, Binasoybean-6, SGB-1, SGB-3, SGB-4, SGB-5, GC-840). At 15th days after sowing (DAS) plants were exposed to waterlogging condition for 12 days period. The waterlogging stress reduced plant height, relative water content (RWC), above ground fresh and dry weight, SPAD value, leaf area, no. of leaves, no. of branches, no. of pods plant⁻¹, no. of seeds pod⁻¹, grain yield plant⁻¹, 100-seeds weight, stover yield, biological yield, harvest index (%), whereas increased mortality rate, electrolyte leakage, proline (Pro) and malondialdehyde (MDA) content. It can be concluded that waterlogging remarkably reduced the growth and yield of all the soybean genotypes when compared with their respective control plants. Among the 12 genotypes Sohag, BARI Soybean-5, GC-840, Binasoybean-1, Binasoybean-2 performed better than the other genotypes under waterlogging. These genotypes showed greater number of adventitious roots in their stem under waterlogging stress. Aerenchyma cells were also found which probably helps the plants to thrive under waterlogging stress condition.

Keywords: Abiotic stress, waterlogging stress, relative water content, electrolyte leakage.

SUSTAINABLE EMPOWERMENT OF TRIBAL WOMEN THROUGH OUTREACH PROGRAMMES

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As stated by Mahatma Gandhiji ,As long as women of India do not take part in public life there can be no salvation for the country. Women are a vital part of the Indian economy constituting one-third of the national labour force and a major contributor to the survival of the family. Studies on women in agriculture conducted in India revealed that by and large women were found doing manual, low prestige, hazardous, arduous, monotonous, repetitive and time consuming jobs viz., transplanting, picking, weeding, harvesting and processing. The apex court (2016) said that Indian women are no longer passive recipients of the states' welfare schemes, but active agents of change, real development is only possible with their socio economic empowerment. Based on the Women Empowerment Index (WEI) score, from the category of "high to very high" level of empowerment of Thondamuthur block, Tmt. Valliammal, was selected as successful farm women. With the introduction of out reachprogrammes viz., TANWA , BDOs, KVIC, NGOs like CSSR, NERD she became aware of real developmental activities. They arranged all kinds of meetings, demonstrations, scientific way of crop cultivation, income generating activities etc., In continuation of this, as an extraordinary sincere effort made by her was appreciated by the officials and appointed her as the President of Marudham Tribal Women's Federation (MTWF). Thus the results of the case analysis is tangible for the various empowerment dimensions such as extension, social, economic, scientific, psychologic and political dimensions. Ultimately these empowerment dimensions contributed towards the "high to very high" level of empowerment.

Keywords: Empowerment, developmental activities, empowerment dimensions,MTWF.

GGE BILOT AND AMMI ANALYSIS OF YIELD PERFORMANCE OF PROSO MILLET (*Panicum miliaceum* L.) GENOTYPES

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The experiment was conducted using seven proso millet germplasm including one check variety, BARI Cheena-1 (BC-1) across 3 locations (Gazipur, Jamalpur and Rangpur) of Bangladesh during 2019-20. The objective of this study was to analyze the stability of proso millet lines and verify the influence of environments on yield at different locations of Bangladesh in the productive performance of the genotypes using AMMI analysis and genotype and genotype by environment interaction (GGE) biplot methods. The results of the AMMI analysis indicated that main effects due to genotype (G), environment (E) and GE interaction were significant, representing differential responses of the lines to the environments and the need for stability analysis. According to the

AMMI stability parameter BD-1447, BD-1411 and BD-777 were the most stable lines across environments, and among them BD-777 recommended as the most stable line for variable environments. Biplot showed the environment of Rangpur was poor; but that of Gazipur and Jamalpur were rich for proso millet cultivation. Results suggested also that BD-1447, BD-1411 and BD-777 could be included in breeding program due to their higher grain yield.

Key words: GGE biplot, Yield, Stability, Proso millet

ASSESS THE TREATMENT OF WASTEWATER BY BENTONITE AND BIOCHAR FOR AGRICULTURE PURPOSE

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Today the use of municipal wastewater as an alternative source of water for irrigation purpose is a common practice. The Adsorption process is the most effective and economical method with high potential for removal and recovery of contaminants from wastewater. In this work, the effect of bentonite and biochar on wastewater treatment and its chemical and physical properties was examined. The bentonite and biochar were characterized by different techniques. The treatment of wastewater by adsorption onto bentonite or biochar were carried out by using the fixed bed column model. Total organic carbon, heavy metals, major cations and anions, EC, and pH were determined before and after the treatment process. Wastewater purification occurred with a flow rate of 250 ml/hour for each 10 g bentonite or biochar. The effects indicated that the bentonite was much better in wastewater treatment than biochar and this refers to the total active and binding sites and functional groups on bentonite were more than on biochar. Moreover, sodium adsorption ratio (SAR), total dissolved solids (TDS), EC, and pH of the treated wastewater by bentonite and biochar were determined to test its using in irrigation purpose. The interesting outcome of this study is that treated wastewater is an effective source for new water. It is encouraging to reuse wastewater in different system application after full treatment.

Keywords: Bentonite, Biochar, Wastewater, Treatment, Contaminates

EFFECT OF STORAGE CONDITIONS AND STORAGE DURATION ON SEED QUALITY OF RICE AND MAIZE

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Both amount and quality of seed losses are associated with traditional storage structures. Improved storage technologies have been tested and found effective in reducing storage losses. Thus the effect of different storage conditions (moisture content of seed at the time of storage, $12 \pm 0.15\%$ and $13.5 \pm 0.18\%$; storage containers namely metal bin, earthen pot, Purdue Improved Crop Storage (PICS) bag, and jute bag), and different storage periods over 8 months on seed moisture content, seed germination and vigor of rice and maize collected from Chitwan, a district of inner Terai of Nepal, was determined in a lab experiment conducted on central seed testing laboratory, seed quality control center (SQQC) Hariharbhawan, Lalitpur under two factor complete randomized

design (CRD) with four replications. Data were collected on moisture percentage, insect population, germination percentage, and root and shoot length, root dry mass and shoot dry mass at just before of storage and also at 45, 90, 135, 180, and 240 days after storage (DAS) as per the International Seed Testing Association (ISTA) standard rule. The germination percentage, both root and shoot length and dry mass decreased in the seeds of both crops stored into different storage devices and with increasing storage duration whereas the number of insect population were increased in the seeds stored mainly in metal bin, earthen pot, and jute bag. The seed stored in the higher moisture level and stored in PICS bags and metal bin had significantly ($p < 0.05$) higher on the seed moisture at 240 days of storage. Though the rice seeds stored at lower moisture level at the time of storage resulted the significantly ($p < 0.05$) higher germination percentage, but the effects of moisture of seeds at the time of storage was not significant ($p > 0.05$) for the seeds stored at earthen pot and Jute bags. For the maize also, seeds stored at lower moisture level resulted the significantly ($p < 0.05$) superior germination percentage. Seeds of maize were completely damaged after 200 days when stored in metal bin. Up to 180 days of storage germination of maize seeds stored in the PICS bag and Jute bags were significantly ($p < 0.05$) higher but the effect was not significant ($p > 0.05$) thereafter.

Keywords: seed quality, seed storage, PICS bag, seed moisture content

APPLICATION OF BIOCHAR PARTICLE SIZE AS SOIL CONDITIONER FOR IMPROVING CHEMICAL PROPERTIES OF SANDY SOIL AND YIELD PRODUCTIVITY

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The use of biochar as soil amendment, either alone or in association with fertilizer, may be considered a specific management for improve the soil properties which adverse crops productivity. Field experiment was conducted in sandy soil at Ismailia Agriculture Research station, Ismailia Govern., Egypt. Institute farm is located at $30^{\circ} 35' 41.9''$ N Latitude and $32^{\circ} 16' 45.8''$ E longitude, during two successive seasons, summer season (2018) cultivated with Lupin (Lupinus sp. Giza 1) and winter season (2019) cultivated with Peanut (Arachis hypogaea. Giza 1) to the effectiveness of different biochar particle size and application depth to improve the some chemical properties, nutritional status and yield components of both Lupin and Peanut crop. The experiment included four particle size of biochar (2, 5, 10 and < 10 mm) and three application depths (0-15, 15-30 and 30-45 cm).

Results indicated that, generally, the application of biochar particle size with different application depth led to increase Lupin and Peanut yields along with their total content of macronutrients (N, P and K) as compared to control treatment. Also, the application of 10 mm particles size at depth (15-30 cm) and 2 mm at depth (0-15 cm) was significantly superior for Lupin and peanut yield and their total content of macronutrients, respectively. Moreover, application 10 mm particles size of biochar was superior increased EC and OM values of Lupin soil as compared to control or other treatments, but in the peanut soil the treatment was 2 mm particles size of biochar. An opposite trend for pH values which were superior decreased in presence of the same treatments.

Regarding the effect of different treatments of biochar on nutrient (N, P and K) availability in soil at both tested seasons, results indicated that the same trend observed previously with different effect of

depth using. In conclusion, the application of biochar as soil conditioners increased organic matter in soil, as along run and reflected that on yield components along with total content of macronutrients under conditions of experiment.

Keywords: Biochar, Particle size, Depth application, Soil conditioners, Sandy soil.

SILICON ADSORPTION ON CLAY SOILS AFFECT BY SILICON AND PHOSPHORUS ADDITION USING FREUNDLICH ADSORPTION MODEL.

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Silicon (Si) is an element, not essential, but is beneficial for some plants. The Freundlich model was used to describe Si adsorption on soil samples incubated with different Si and phosphorus (P) concentrations. Soil incubated samples were: T1 soil had no Si or P (control); T2, T3 and T4 soils contained 50, 100, and 200 mg Si L⁻¹, respectively. T5 and T6 soils contained 50 mg Si L⁻¹ in combined with either 7 or 10 mg P L⁻¹ along with T7 and T8 soil contained 100 mg Si L⁻¹ in combined with either 7 or 10 mg P L⁻¹. Finally, T9 and T10 soil contained 200 mg Si L⁻¹ in combined with either 7 or 10 mg P L⁻¹. A series of adsorption experiments were performed using sodium metasilicate pentahydrate (Na₂O₃Si₅H₂O) solution prepared to have concentrations representing 0, 14, 28, 42 and 56 mg Si L⁻¹ in combination with phosphorus at the concentrations of 50 and 100 mg L⁻¹ using Ca(H₂PO₄)₂ salt. The supernatant of Si concentration was determined. The amount of element adsorbed was calculated as the difference between applied element concentrations and that remaining in solution after equilibration. Adsorption isotherms were determined at room temperature (25°C ± 1).

Results revealed that a positive trend was generally found; increases in amount of adsorption onto soil with increasing Si concentration and equilibrium concentration under both P applied concentrations in concerned solution either applied separately or applied + initial available Si concentration in soil. The Freundlich equation provides a good fit to the sorption data for all incubated soil samples and R² values were ranged from 0.6 to 0.8. Present study indicated that adsorption capacity value (K_f) decreased from T1 to T4 soil samples under both P applied concentrations but K_f values under 100 mg L⁻¹ P was lower than its under 50 mg L⁻¹ P, and intensity adsorption values (1/n) gave almost an opposite trend to that of capacity adsorption (K_f) values. Moreover, adsorption of Si onto soil incubated with different Si concentrations in combined with P₂ decreased as compared to P₁ under both P applied concentrations. Also, present study showed that the higher values of K_f obtained in P₁ incubated soils (T5, T7 and T9), compared to K_f values of P₂ incubated soils (T6, T8 and T10), and intensity adsorption values (1/n) gave almost an opposite trend to that of capacity adsorption (K_f) in both P₁ and P₂ soils. Finally, large Si sorption capacity and low Si affinity for the surface sites were observed in soil incubated with high Si concentration compared to soil incubated with low ones.

Keywords: Silicon, Phosphorus, Interaction, Adsorption, Freundlich equation

**IMPORTANCE DE L'INVESTISSEMENT DANS LE RECYCLAGE DES DECHETS
ALIMENTAIRES : AVANTAGES ET INCONVENIENTS
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Food is the first concern of humans from a biological point of view. Indeed, it is vital for humans to eat. It must at the same time cover human needs by avoiding deficiencies, move away from repetitions to avoid overloading, match the rhythms of life, the social and cultural context while remaining open to "the other" and finally guarantee safe use to meet the concerns of doctors.

At the same time, food waste results after feeding humans. This waste represents almost a third of the volume of household waste. This is kitchen waste, such as leftover meals or peelings. It covers all food waste (leftover meals, tray returns, food preparation waste, etc.) originating in particular from households, restaurants, caterers or retail stores and establishments producing or processing foodstuffs. Therefore, the recycling of this waste by an adequate transformation allows to give different organic and inorganic. These concepts demonstrate the potential role of investing in recycling food waste. It is necessary to establish a recycling, control and popularization program for all stakeholders in the sector in order to improve the quality and quantity of the food waste recycling products obtained and thus minimize the significant economic losses thereafter

Keywords: Food waste, recycling, investment, man

BIOSURFACTANT IN MEDICINE: A COVID-19 PERSPECTIVE

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Objective: In the perspective of current pandemic of Coronavirus Disease 2019 (COVID-19), there is a global public health emergency as the death toll is rising, and scientists are looking for newer anti-viral agents.

Hypothesis: Biosurfactants (BSs) are, microbially produced, amphoteric compounds that possess marked surface and emulsifying activities. They comprised of a wide range of chemical structures like glycolipids, lipopeptides, phospholipids, neutral lipids, fatty acids, and polysaccharide-protein complexes. Their antimicrobial properties such as anti-bacterial, anti-fungal, and anti-viral activities make them appropriate therapeutic agents in combating many diseases.

Method: Literature was searched on immuno-modulation and anti-microbial especially anti-viral properties of biosurfactants and their mechanism of action to write this article.

Result: The structure of the coronavirus is reliant on the integrity of its lipid membrane enclosing proteins and nucleic acids. BSs, because of hydrophobic domains within their amphiphilic structure, hold the intrinsic ability to disrupt this membrane to kill the virus. Moreover, it is observed that the COVID-19 patients show elevated levels of cytokines, because immune system installs many immune cells such as pro-inflammatory cytokines (TNF- α , IL-6, IL-8, IL-12, IL-18 and IL-1 β) in response to the virus entry to the host cell. When such a kind of cytokine storm is formed, the immune system become exaggerated and kills healthy cells as well. In addition, enhanced levels of IL-6 and lymphocytes leads to the increased pulmonary damages. It has been reported that various

BSs have anti-inflammatory potential by inducing the production of cationic proteins, reactive oxygen species and lysozyme. Because of both cationic and anionic groups in BSs, they are used in medicine as drug delivery agents, and in cleaning products like soap and detergents.

Implication: The exploitation of BSs for therapeutic purposes against COVID-19 is justifiable in dealing with the symptoms, targeting virus-infected cells, and in preventing the spread of the corona virus as cleaning agents. We speculate that this study would be fruitful to accelerate the drug-search in combating the mankind against the pandemic state.

Keywords: Anti-inflammatory, anti-viral, biosurfactants, COVID-19, cytokines.

DIVERSITY OF PLANT AND SOIL NEMATODES AND DESCRIPTION OF A NEW SPECIES OF PREDATORY NEMATODE *DISCOLAIMUS* SP. N. ASSOCIATED FROM DISTRICT SAHARANPUR (UTTAR PRADESH)

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Study was undertaken to explore diversity and community structure of soil and plant nematodes associated from district Saharanpur (Uttar Pradesh) in 2019-20. During the survey, collected 48 soil samples from different localities of five to six villages of each thesilviz., Deoband, Nakur, Saharapur and Behat of district Saharanpur. Different nematode genera and trophic groups were assessed in terms of absolute frequency, relative frequency, density, relative density, prominence value and relative prominence value. Results showed that, total 32 nematodes encountered, among them 15 belong to plant feeder nematodes, 9 belong to predatory nematodes and 8 belong to microbivorous nematodes. All microbivorous nematodes reported first time from this region. Community analysis data analysis showed that, *Rotylenchulus reniformis* was more frequent, while *Hoplolaimus indicus* most abundant and prominent nematode in the plant feeder nematode community, whereas *Eudorylaimus* sp. and *Cephalobus* sp. was more frequent in predatory and microbivorous nematodes community, respectively. Additionally, we also encountered a new species of a predatory nematode *Discolaimus* sp. n. (Nematoda: Dorylaimida). This new species is identified based on morphological and molecular characterization. This study indicated that a great diversity of nematodes fauna are still unexplored and there is an urgent need to explore diversity of both beneficial as well as harmful nematodes from Saharanpur.

Key words: Diversity, Community analysis, Nematodes Saharanpur

A BIO-SECURITY THREAT LOOMING LARGE: WHEAT BLAST DISEASE

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Wheat blast disease known as “Bruson” was reported first time from Brazil in 1985 and it has recently emerged as one of the most damaging fungal diseases of wheat, next only to the deadly rusts. After the entry of wheat blast in Bangladesh in the year 2016, the entire South Asia inhabiting the one fourth of the world’s population has suddenly become extremely vulnerable to it. The impact of a 5-10% reduction in wheat yield caused by WB has been estimated to be as high as USD 132-264 million. The disease is of specific importance to India which is the second largest wheat

producer of the world and where wheat is the second most important source of calory intake after rice.

The genetics and epidemiology of the wheat blast is not fully understood and the early warning systems are not in place, making the disease extremely difficult to manage. A very high propensity of WB becoming pandemic to a particular geographical localization takes the threat to the next level. Therefore, constant surveillance, quarantine and blocking the entry of the disease into new geographies seems to be the most practical approach of its control.

However, it can under no situation underestimate the necessity of development of resistance varieties with wider stability through identification of resistance sources and genes, understanding the genetic architecture to take advantage of introgressive breeding. Not only the identification but also the diversification of genetic resistance remains one of the most important but challenging aspect of wheat blast research and development as the availability and durability of non-2NS resistance has been shown to be very low. Moreover, the geographic confinement and quarantine of the disease also warrants the urgency of holistic and concerted efforts in collaboration with national and international partners.

Until now, the WB is not present in India. India shares a 4,096 km long International border with Bangladesh, the longest with any country. This geographical proximity to the South Asian epicentre of WB, puts 21% of India's total wheat area vulnerable to this disease. Mottaleb *et al.*, (2019) have estimated a loss of 0.8–1.6 million tons worth USD 122–244 million assuming a meagre 5–10% yield loss. However, given the climatic sensitivity of the region, the extent of yield loss could be as high as 70% and this situation with wheat being 27% of the total food production of the country, can prove extremely precarious to a major proportion of the country's population. Already, the weather-based forecasting has shown the very high vulnerability of the NEPZ and Central zone of the country and if in some hot and humid year the WB outbreaks happens in the main north western plain zone (NWPZ) the consequences can be potentially catastrophic. However, the response of the Government of India to the threat of WB has been unprecedentedly proactive which went on in immediate putting of awareness, surveillance and monitoring modules in the affected/vulnerable India-Bangladesh border areas. A strict internal and external quarantine, proper seed health testing for MoT, enforcement of standard guidelines for safe movement of germplasm etc have been put in place by the Government of India. Moreover, as an extra precautionary step for controlling the transmission of WB into India, the wheat crop in border areas was burnt in the year 2016 to break the chain of infection. The "wheat holiday" i.e. banning the wheat cultivation in the Murshidabad and Nadia districts in the West Bengal state of India and within 5 km border area of West Bengal and Assam states is a much-lauded emergent act of India for stopping the WB to enter into the country. In these areas, alternative non-poaceous crops like gram, urid, oilseed crop such as rapeseed and mustard and potatoes have been recommended to the farmers in winter season.

The way forward for WB is primarily to think of strategies and way outs for restricting the disease to Bangladesh in Asia and to the hotspot countries of Latin America, if its complete salvation is impossible. The vulnerability of South Asia needs to be brought down through decreasing the inoculum load in Bangladesh. This can be accomplished through non-wheat seasons, non-poaceous crops in the off season, supply of disease-free resistant variety seeds, agronomic practices favouring non-development of the disease, development and implementation of integrated disease management practices and continuous monitoring of disease movement and quarantine. The early warning systems based on climate analogues needs to be developed for the vulnerable areas primarily and economic and quarantine importance of the MoT pathogen needs to be understood minutely. The detection of symptoms before the heading stage under field conditions is a major challenge in timely mitigation of the disease. The comprehensive understanding of the disease

epidemiology and development of molecular diagnostics for disease diagnosis should be high on priority in the battle against WB. The identification of novel sources of genetic resistance particularly, a search targeting the wheat wild relatives, including the synthetics and their eventual deployment in the superior cultivars constitutes the major frontier to successfully tackle the menace of WB.

The presentation sums up the state of research and development on different aspects of the wheat blast disease with particular focus on disease management and mitigation strategies, diagnosis, spread, pathogen biology and its importance in context of Indian wheat production systems.

PATH TO DIVERSIFIED AGRICULTURE SECTOR

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Agriculture sector in India has shown rapid strides since Green revolution, taking India to the path of National Food Security and more precisely, self-reliance in food production. However, despite the remarkable performance in agriculture sector, India is still amongst the bottom 50 countries in terms of Global Food Security Index (GFSI). The GFSI considers the core issues of affordability, availability and quality across a set of 113 countries. Poor protein quality, low dietary diversity and low micro-nutrient availability are the key factors resulting in the low food security index. Both in terms of affordability and availability, agriculture sector in India is extremely narrow. On the demand side, large section of the Indian population come under various food safety net programs that gives them easy access to food grains but can barely afford nutritious food. Similarly, on the supply side, with various measures taken by the government to incentivise production of cereal crops, like, rice & wheat, there is a huge disbalance in agricultural production across geographies. Food security of any nation, therefore, depends on how food of high nutritious value can be made affordable to the entire population. Several researchers and policy makers highlighted the need for 'Right crop in right geography' for diversification of agriculture sector. However, the shift to crops of high nutritious value is possible if farmers are incentivised with higher returns. Many proven technologies and planting improvement practices have promises to boost returns and reduce cost of production. This study aims at identifying the expected profitability of farmers by either shifting from rice cultivation to other crops of high nutritious value or intercropping other crops with rice across states.

IRRIGATION WATER MANAGEMENT ECONOMICALLY

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The post-World War II era saw a significant increase in irrigation activities that contributed greatly to the massive growth in agricultural production that enables humanity to feed its multiplying population. However, a distinction must be made between the overall positive contribution of irrigation and water to agricultural productivity and economic well-being, and a great deal of

misallocation and mismanagement of the resources that accompanied the expansion of irrigation. In many cases, water resources were too much; there was excess spending on capital; And significant costs in terms of loss of ecosystems, extinction of fish species, and pollution of water sources. This research provides an economic perspective on the contribution of irrigation and water resources to past agricultural development and future water resource management. Water use efficiency is affected by decisions taken at many levels. In this research, we first analyze the shortcomings that can occur at different levels of water management. We start with a discussion of the use of irrigation water by the individual, and then we turn to the importance of regional water management. Then we discuss the importance of dynamic considerations about the future and the role of interregional management. Together, these departments provide an economic framework for designing water institutions and policies to improve the allocation of water resources and prevent some of the current deficiencies in water resource systems. The second part of the research provides an overview of the benefits and costs that have been achieved through agricultural water and irrigation projects in developing countries. There is a dearth of posterior integrated evaluations of these projects, so we grouped the parts together, gathering data with conceptual arguments.

Keywords: Irrigation, water resources, developing countries, water management, economic.

GENOTYPE BY ENVIRONMENT INTERACTION AND YIELD STABILITY ANALYSIS IN PROSO MILLET GERMPLASM IN BANGLADESH UNDER RAINFED CONDITION

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A Genotype by environment analysis was carried out to select high potential genotype for the grain yield stability of ten proso millets (*Panicum miliaceum* L.) germplasm including one check variety BARI Cheena-1 (Tusher) across three different locations of Bangladesh viz. Rajshahi, Gazipur and Gaibandha under rainfed condition. The experiment was carried out during rabi (winter) season of 2019-2020 to find out water use efficient genotypes across the environments. Tested genotypes got one irrigation right after germination and rest of the life cycle grew under rainfed condition. Stability and environment interaction (GGE) biplot were analyzed to evaluate these genotypes. Analysis of variance for yield characters exhibited the presence of genetic variabilities among the environment and genotypes. Considering overall mean grain yield across the locations BD-1488, BD-1446, BD-791 and BD-1402 were relatively high yielder under rainfed condition. Gaibandha was the most suitable environment among the tested locations for proso millet cultivation in Bangladesh.

Keywords: Proso millet, Genotype-Environment Interaction, Stability and Rainfed

DISTRIBUTION PATTERN, CULTIVATION STATUS AND CONSERVATION STRATEGIES FOR *Inularacemosa* HOOK.F.

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Investigations were conducted in the laboratory and experimental fields of Department of Forest Products, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, (H.P) at Herbal Garden Nauni, Shilly (Solan) and Manali (Kullu). Observations are based on distribution pattern, cultivation practices, and production technology and conservation strategies. Surveys and germplasm collections were made from different eight sites *i.e.* six from Himachal Pradesh (Lahaul&Spiti) *i.e.* Keylong, Kardang, Dalang, Sissu, Udaipur and Kukumseri and two from Jammu & Kashmir (Kashmir valley) *i.e.* Tangmerg and Shopian were selected. Apart from cultivation practices personal observations were recorded with proper discussions and monitoring and evaluations. Among the pre-sowing treatments under laboratory and field conditions maximum germination per cent was recorded in treatment P₄ (GA₃ 150 ppm) and minimum in control. Maximum germination energy (19.20) per cent was recorded in treatment P₅ (GA₃ 150 ppm) and minimum in P₈ (IBA 150 ppm). The maximum germination speed was recorded in treatment P₆ (IBA 50 ppm) and minimum in control. The maximum mean daily germination was recorded in treatment P₅ (GA₃ 150 ppm). The maximum germination per cent and seedling height was recorded in seeds treated with P₅ (GA₃ 150 ppm). The maximum collar diameter (4.17 cm) and seedling vigour index (4236.0) was recorded in pre-sowing treatment P₅ (150 ppm GA₃). The maximum fresh shoot weight (54.10 g) and dry shoot weight (27.77 g) was recorded in treatment P₅ (GA₃ 150 ppm). The maximum fresh root weight (9.32 g) and dry root weight (4.64 g) was recorded in seeds treated with P₅ (GA₃ 150 ppm). The maximum root length (11.77 g) was recorded in treatment P₅ (GA₃ 150 ppm).

Keywords: Inula, Germplasm, Cultivation, extraction

WASTEWATER IRRIGATION AND ECONOMIC ANALYSES

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In the context of persistent drought, the search for alternative water sources and increasing environmental restrictions on discharging treated wastewater into natural water bodies, recycling treated wastewater offers a potential solution. Population density and freshwater resources are not distributed evenly around the world. This forced farmers to use wastewater to irrigate food crops. This practice presents both positive and negative effects in relation to agricultural use, as well as in the context of environmental pollution and toxicology. Although wastewater is an important source of essential nutrients for plants, many environmental, health and health risks are also associated with the use of wastewater to irrigate crops due to the presence of toxic pollutants and microbes.

Wastewater reuse in agriculture has been identified as a way to alleviate water scarcity, improve crop productivity and improve environmental sustainability. Given that agriculture is the largest user of fresh water and wastewater irrigation. Although wastewater reuse in agriculture has high returns and may have ecosystem benefits, there are some costs associated with its use (wastewater treatment, health, environment and environmental costs) This paper has developed an integrated systems modeling framework that will contribute to Design comprehensive wastewater management systems that make the use of wastewater safer and more sustainable without relying on unaffordable treatment techniques. In addition, the study places wastewater on the policy agenda by demonstrating the economy and environmental benefits of wastewater reuse in agriculture as well as An assessment of the potential trade-offs that must be taken into account when planning wastewater reuse in agriculture.

Therefore, in this review, we highlight and compare the current scenario of wastewater production economically and its use for irrigation of crops and the associated environmental and health risks at the national and global levels. Moreover, the review traces the history of wastewater use to irrigate crops and suggests some future perspectives and management strategies to reduce the risks associated with using wastewater to irrigate crops. In addition, some integrated sustainable solutions and future prospects policy were also proposed, taking into account the regional and global context, as well as the ground reality of using wastewater for crop production, sanitation issues and planning, treatment techniques, awareness among civil society, the role of government and relevant stakeholders.

Keywords: wastewater reuse; Crop irrigation; integrated sustainability; Techniques, Environmental benefits, economic, and management strategies.

**SCREENING OF SALINITY TOLERANT TOSSA JUTE (*Corchorus olitorius*)
GENOTYPES VIA PHENOTYPIC ASSISTED PROCEDURES AT GERMINATION
STAGE**

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Salinity is a serious abiotic stress threatening the cultivation of field crops in the world. Six tossa jute (*Corchorus olitorius*L.) genotypes (Acc. 1141, Acc. 1089, Acc. 3801, Acc. 4584, Acc.1192 and Acc. 1407) were evaluated to investigate the salinity stress at germination stage in artificial condition under six levels of salt concentrations i.e. control 0.00 or d.H₂O, 8.0, 10.0, 12.0, 14.0 and 16.0 dSm⁻¹ NaCl (T₀, T₁, T₂, T₃, T₄, T₅, resp.) in RCB design at Bangladesh Jute Research Institute during March, 2020. Seeds were collected from the Gene Bank of BJRI and allowed to germinate in laboratory condition. The more NaCl concentrations increased the adverse effects on seed germination. The delay of germination prolonged with increasing salt concentrations. In control varieties, seeds were germinated up to 14.0 dSm⁻¹ salt solution. Among all genotypes, Acc. 1141 and Acc. 3801 gave the highest germination ability (86.67%) under 14.0 dSm⁻¹ salt solution. The highest root length (17.0mm), dry biomass (6.37mg) were recorded in Acc. 3801; the highest shoot length (10.0mm), fresh weight (43.93 mg), salt tolerance index (60.69%) were recorded in Acc. 1089 under 14.0 dSm⁻¹. Both the Acc. 1141 and Acc. 3801 showed maximum relative salt harm rate for seed germination under 14.0 dSm⁻¹ salinity indicating highly tolerance to salinity. The Acc. 1141, Acc. 3801 and Acc. 1089 showed good performance under salinity stress at germination stage and would be used as breeding materials for salinity tolerant varietal development. The study revealed that salinity stress has inhibitory effect on both seed germination and seedling growth of tossa jute genotypes.

Keywords: Abiotic stress; *Corchorus olitorius*; Salinity tolerance; Gene bank; Salt tolerance index;

ENVIRONMENTAL ARCHITECTURE AND ECONOMIC SUSTAINABILITY DEVELOPMENT

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Sustainable architecture aims to design buildings and infrastructures, and sustainable construction has four dimensions: environmental, social, economic and technical. Sustainable architecture technology contributes to sustainable development, and thus to the development of future generations. The concept should not only incorporate bioclimatic strategies but also economic, social and cultural aspects. From an economic point of view, sustainable building is an extraordinary activity that changes business patterns from a linear process to a cyclical process. It is necessary to detail the economic principles of sustainable construction and investigate their application in practice. Economic research on sustainable architecture is conducted while the design process is taking place, but it also focuses on the built environment through the historical time of a place. The aim of this article is to bring new perspectives on sustainable environmental architecture to academic debate and to discuss the relationship between environmental architectural elements, economics, challenges and strategy for achieving aspects of sustainable architecture.

Keywords: environment, economical, sustainable, architecture.

INFLUENCE OF PACKAGING AND STORAGE ON THE QUALITY OF OSMODEHYDRATED APRICOTS (*PRUNUS ARMENIACA L.*)

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The study was designed to find out the suitable packaging material for storage of osmodehydrated apricot (Var. CITH-2), prepared by using 60 °brix syrup containing 2000 PPM KMS, followed by cabinet drier at 58 ±2°C till 8% moisture content, then packaged in pouches of ALPE (250 g), HDPE (200 g), LDPE (200 g) and Shrink wrapping (150 g), prior to storage for six months at ambient conditions. During storage significant decrease in physicochemical and functional quality in term of antioxidants capacity (61%), total phenolics (50%), total flavonoids (38%), total carotenoids (30%), β-carotene (29 %), ascorbic acid (64%), and titratable acidity (33%) was observed, while moisture content, total sugars and reducing sugars observed to slightly increase during storage. Among the packaging materials, ALPE (250 g) was found to be good for retention of better quality, better color and higher sensory score of the osmodehydrated apricot.

WEED MANAGEMENT IN TRANSPLANTED RICE WITH SPECIAL REFERENCE TO COMMELINA BENGHALENSIS IN MADHYA PRADESH

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Rice is the most widely cultivated rainy season's cereal in Madhya Pradesh. Owing to favourable weather and soil moisture regime, Commelina spp. infestation is a major biotic constraint to rainy rice production. In Madhya Pradesh, four species of Commelina, notably *C. communis* L., *C. diffusa* Burm., *C. elegans* Kunth and *C. benghalensis* L. as well as their biotypes are present. They are perennial herbs and considered as important problem in prevalent cropping systems where they have become continual and become difficult to control. *Commelinabenghalensis* is the most important among four and it occurs as a major weed in 25 different crops in 28 countries. *C. Benghalensis* have been found infesting different field crops during rainy season especially rice fields. Season-long infestation of this weed alone causes grain yield reduction by 13-40% and removes considerable amount of soil nutrients. During 2014-17, an on-farm research trial was conducted at five farmer fields in Katni district of Madhya Pradesh to validate, refine and popularize the technology for managing *Commelinabenghalensis* L. The study aimed to find out the efficacy of bispyribac-sodium 20g/ha, pyrazosulfuron 20 g/ha and pendimethalin 1.5 kg/ha over farmers practice (hand weeding twice at 30 and 60 DAT) and unweeded control on the management of weeds and profitability of rice (*Oryza sativa*) sown in transplanted condition. Bispyribac-sodium 20 g/ha at 20-21 DAT reduced the density of *Commelinabenghalensis* upto 9.8 no./ m² and dry weight upto 6.9 g/m² and also reduced the infestation of other weeds to a significant extent. Higher values of yield attributes such as number of panicles (229/m²), grain yield (3.46 t/ha) and net returns (₹ 31820), as well as less values of nutrient uptake by weeds (5.8 kg N, 1.1 kg P and 6.9 kg K/ha) were recorded with this herbicide compared to farmers practice.

Keyword: Bispyribac-sodium, *Commelinabenghalensis*, Farmers practice, Pendimethalin, Pyrazosulfuron, Rice, Weed

SOCIAL IMPACT OF SELF HELP GROUP PARTICIPATION ON TRIBAL WOMEN IN NAGALAND

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SHGs have been organized to mobilize the rural women by providing financial credit and technological support. Majority of the rural women are also deprived of social alleviation schemes from the formal financial institute due to complicated procedure for availing such benefits. Financing agencies ignore individual member particularly in poor socio economic background as not viable to provide loan as they are economically poor and socially weak. The present study was undertaken, to study the social impact of the Self Help Group members on Self Help Group participation among tribal women in Nagaland. Multistage purposive random sampling method was adopted for selecting the sample of SHG participants. A total of 360 SHG respondents from 120 identified SHGs were selected for the study. In this paper an attempt has been made to assess the social impact of SHGs members on SHGs participation. Social variables viz., self confidence and

self worth, decision making ability, social responsibilities and awareness, skill enhancement, access to social infrastructural facilities were discussed. Paired t-test was used to analysis the social impact by comparing before and after situation of SHGs participation. It was found out that there is a significant difference in the mean score after SHGs participation. Thus it is evident that, SHGs participation provides a platform for women to participate in various social issues for inclusive growth and remove social barriers and improves their social wellbeing.

Key word: Empowerment, Tribal, Women, Self Help Group, Nagaland.

**PRECISION BEEKEEPING: THE USE OF INFORMATION TECHNOLOGY IN
BEEHIVE MONITORING
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Precision apiculture a branch of precision agriculture, recently defined as an apiary management strategy based on the monitoring of individual bee colonies to minimize resource consumption and maximize the productivity of bees. Although beekeeping is the traditional branch of agriculture, still many manual operations are being done to take care of the bee colonies. Therefore, the application of Precision beekeeping (PB) and information technologies can be used by the beekeepers to minimize the manual work, to improve the beekeeping practice, to monitor the health and the productivity of beehive colonies. It can be implemented by data collection, data analysis, and application. Different sensors can be used for monitoring the bee colony and data collection process. In the data collection process, apiary level factors like nectar availability, application of pesticides within the foraging area, noise or other disturbances close to the apiary, theft, diseases, and video technologies can be used for apiary level monitoring to observe the apiary. Colony level parameters like temperature, humidity, sound, the vibration of hive weight can be used to make colony-level decisions. Monitoring of the colony temperature can be performed by using various methods like manual temperature, wired sensor networks, wireless sensor networks, and infrared imaging measurements. Temperature data can help to identify colony states like death, swarming, brood rearing, and broodless state. Weight monitoring of the colony helps in identifying the occurrence of nectar flow during the foraging season, consumption of food during non-foraging periods, the occurrence of swarming events through a decrease in the hive weight and estimation of the number of foragers. Finally, several levels of information can be made using the PB approach based on colony level, apiary level, bee farm level, and regional level. Data analysis can be performed by the beekeeper or by the decision support systems (DSS) from the collected data. The results from the PB could provide specific indications for the beekeepers to minimize product losses, to improve the health of the hive, honey yield, and health of the hive.

Keywords: Apiculture, Apiary, Beekeeping, Hive, Precision, Technologies.

**ANATOMICAL STUDIES OF SOME TOSSA JUTE GENOTYPES COMPARING WITH
JRO-524 (NAVIN) AND BJRI TOSSA PAT-8 (ROBI-1)**

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Development of high yielding tossa jute (*Corchorusolitorious* L.) variety is not easy task due to its narrow genetic base. For identification of good fiber quality and higher yield it is necessary to study

fibre development potentiality with fibre contributing character like plant height, base diameter, plant population etc. This study was carried out to observe anatomical feature of eleven different tossa jute genotypes (collected from preliminary and advanced yield trials of BJRI) including check varieties JRO-524 and BJRI Tossa Pat-8. The materials were grown at Jute Agricultural Experiment Station, Manikganj, Bangladesh for anatomical study during March to July 2019 followed by randomized complete block design. In respect of anatomical traits Acc. 1318 gave higher bark diameter, bark thickness, area of trapezoid, number of trapezoids and number of fiber bundles trapezoid⁻¹ from mean data of top, middle and base portion of jute plant followed by Acc. 1306, respectively. But the JRO-524 (red) gave higher bundle layer of trapezoid which was not significantly different with Acc. 1318. In respect of fiber cell, maximum length breadth ratio was found in advanced line O-0419-3-1 which was similar to JRO-524 (green). So from the overall study, Accession 1318 can be recommended to use as parent material in further breeding program to develop high yielding tossa jute variety which can considerably beat up the future challenge.

Keywords: *Corchorus Olitorius*; Fibermaceration; Genotype; Jute Anatomy; Phloem fiber; *Tiliaceae*

IDENTIFICATION OF COMBINING ABILITY PATTERNS FOR GALL MIDGE RESISTANCE IN RICE HYBRIDS IN NORTHERN TELANGANA, INDIA

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Information on the combining ability and heterotic patterns of rice is crucial for the success of hybrid programs targeting the stress environments. This study aimed to develop rice hybrids with resistance to gall midge and make inferences regarding components of heterosis in hybrids obtained by crossing six lines and seven testers in Line X Tester mating design. Forty two crosses and four standard checks were evaluated for gall midge incidence, yield and yield components. Analysis of variance disclosed significant differences among genotypes for most traits indicating existence of variability among genotypes. Combining ability analysis revealed pre-ponderant non-additive gene action for most of the studied traits. A perusal of the GCA effects revealed lines, JMS 20A, JMS 21A and JMS 19A to be good combiners for grain yield per plant and gall midge resistance. Analysis of the specific combining ability effects revealed none of the hybrids possessed consistently high SCA effects for all the characters and the best cross combination was observed to vary from character to character. Hybrids JMS 20A X JBR 6 and CMS 64A X JM BR 31 were found to be good specific combiners for gall midge resistance. Further, eight hybrids had recorded high per se performance, heterosis and desirable SCA effects for grain yield per plant. Among them hybrid JMS 19A X JR 80 involving poor and good combiner parents for grain yield per plant recorded maximum grain yield per plant, significantly positive SCA effect and highest relative heterosis, heterobeltiosis and standard heterosis over checks for grain yield per plant along with moderate resistance to gall midge. Hybrids with desirable SCA, better yield performance and resistance or tolerance to gall midge could be tested in multi-location trials.

Keywords: Heterosis, Combining ability, Grain yield, Gall midge, Rice

DYNAMICS OF INDIGENOUS FARMING SYSTEMS IN ARUNACHAL PRADESH, EASTERN HIMALAYA

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Arunachal Pradesh state of India, encompassing high ethnic diversity is one of the world's biodiversity hotspots in Eastern Himalaya. The local folk are known for their remarkable indigenous knowledge of bioresource utilization, ecosystem conservation, and natural resources management. The present study was undertaken to understand the dynamics of indigenous farming techniques in the context of on-farm conservation and agro-biodiversity management. The knowledge and dynamics of land management itself display their ability to cope with the local environment, signifying the ecologically sustainable management practices. Some major tribes of the states such as, the Wancho, the Tutsa, the Nocte, the Adi, the Galo, the Tangsa and the Nyishi, on the other hand, splendidly converted their undulating hilly terrains into the productive landscape. For instance, upland settled, lowland settled and shifting agriculture are some of the major agricultural practices in this region. Both settled and shifting cultivation are equally responsible for the on-farm conservation of crops germplasm. A total of 59 plant species belonging to 23 taxonomic families were reported to be cultivated and maintained in the traditional farms. The Apatani tribe is known for its distinct traditional integrated farming practice, including innovative and unique rice+fish and bamboo+pine integrated farming techniques. The local crops and vegetables landraces are facing manifold threats from the invasion of foreign plants, rapid modernization, and diversion in occupational choice. Uninterrupted cultivation of these plants in various ecological regimes is essential to conserve agro-biodiversity and utilize their potential for the sustenance of marginal farmers'.

Keywords: Indigenous knowledge, Arunachal Pradesh, jhum cultivation, tribes

WEED MANAGEMENT IN INTENSIFIED AGRICULTURE

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Weeds are undesirable plants under crop production. Weeds not only reduce the yield of crops but are also a great nuisance in forestry, pasture and grass land, orchard, lawn, wastelands, public amenities (rail, road etc) and water bodies. Weed complexity are more in intensified agriculture. Weed population density and biomass production may be reduced using crop rotation and intercropping (temporal and spatial diversification). The success of rotation system for weed suppression appears to be based on judicious use of crop sequence that provide varying system of resource competition, allelopathic interference, soil disturbance and mechanical damage to provide an unstable and frequently inhospitable environment that prevent the growth and expansion of a particular weed species. Integrated approaches of weed management in intensified and diversified agriculture are effective to minimize the economic losses due to weeds, agronomical measures like crop rotation intercropping, enhancement of plant population through increasing seed rate, using zero tillage method and pre-sowing irrigation. However precision farming, drip

irrigation, band placement of fertilizer application, fertigation through drip irrigation is very effective to suppress weed biomass along with significant yield increase. Use of machines (mechanical method) is other effective and economical tool for reducing yield losses due to weeds. Development of intelligent weeders with computer assisted smart vision system to identify and destroy the weeds is one of the ways. Once these new generation machines become commercially available the weed management becomes easier and economical. Efficient water management, soil solarisation, way of fertilizer application using crop geometry are the means which are effective to manage weeds in intensified and diversified agriculture.

Keywords: Weed management, precision farming diversified and intensified agriculture

NEW RECORD OF INVASIVE AILANTHUSDEFOLIATOR *Eligma narcissus* (CRAMER, 1775) (LEPIDOPTERA : NOLIDAE) FROM JAMSHEDPUR, JHARKHAND (INDIA) WITH ITS TAXO-MORPHOLOGY, DISTRIBUTION, LIFE CYCLE, HOST PLANTS AND CONTROL MEASURES

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The present communication deals with the new record of invasive moth *Eligma narcissus* (Cramer, 1775), the Ailanthus Defoliator from Jamshedpur, Jharkhand (India) with its taxo-morphology, (synonymy, classification and diagnostic features), distribution, life cycle, host plants and various control measures.

Key-words: *Eligma narcissus*, new record, Jamshedpur, host plants, control measures.

SIMULATED EFFECT OF DRY SPELLS AT CRITICAL GROWTH STAGES ON THE PERFORMANCE OF KHARIF SORGHUM HYBRIDS

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Impacts of changing patterns of rainfall on *kharif* hybrid sorghum was studied using DSSAT – CERES sorghum model. The calibrated and validated model using 2011 and 2012 experimental data (Manjangoudaet *al.*, 2019) was used to study the effect of simulated moisture stress vis-à-vis dry spells on yield. Scenarios included skipping of rainfall for two weeks and four weeks before panicle initiation as well as before end of grain filling stage. These scenarios were created by using daily weather data of 2011 and 2012. These scenarios were tested on two hybrids (CSH-16 & CSH-23) grown across three dates of sowing (15 June, 30 June and 15 July). As per the treatments rainfall data for two weeks and four weeks before crop reaches panicle initiation and end of grain filling were turned to zero. The simulations for 2011 and 2012 were pooled, compared with observed and presented here. Between two hybrids, CSH-16 performed better than CSH-23 both under observed (5804 and 5506 kg/ha, respectively) as well as stressed environment (3923 and 3429 kg/ha,

respectively). Dry spells for four weeks before panicle initiation simulated higher yield reduction (69.35 %) as compared to dry spell for two weeks before panicle initiation (36.71 %) over observed. Model also simulated that moisture stress before end of grain filling stage has lesser adverse impact on yield both for two and four weeks stressed environment than that of panicle initiation. However, four weeks of dry spell before end of grain filling resulted in maximum yield reduction of 25.25 % as compared to two weeks dry spell before end of grain filling stage (8.98 %) over observed. Similar trend was observed for tops weight, leaf weight, stem weight and root weight. This study showed that dry spells either of two or four weeks before panicle initiation results in maximum yield reduction than two or four weeks before grain filling stage. This study also suggest that to realize higher yields of *kharif* sorghum, crop needs supplemental irrigation during vegetative phase leading to panicle initiation if dry spells occurred. This study also proves that crop simulation models show their applicability as effective tools to assess and quantify impacts of climatic factors on sorghum.

Keywords: DSSAT, CERES-Sorghum, Dry spell, Panicle initiation, Grain filling stage

WATER RESOURCE MANAGEMENT FOR IMPROVISING GROUNDNUT BASED INTERCROPPING SYSTEM

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A two-year field experiment was conducted during the *rabi* season 2017-2019 at Oilseeds Research Station, Tamil Nadu Agricultural University, Tindivanam, Tamil Nadu, India to assess the production potential of different groundnut intercropping systems and thereby optimize its irrigation scheduling. The experiment was laid out in split plot design with three replications. Main plot comprised of five treatments with four intercrops *viz.*, castor (TMV 5), blackgram (VBN 8), sesame (TMV 7), pearl millet (CO 10) and sole groundnut (TMV 13). The sub plot was assigned with three irrigation regimes based on IW/CPE ratio of 0.50, 0.75 and 1.0. Groundnut + blackgram combination recorded higher pod yield (6.31 g plant⁻¹), equivalent pod yield (1986 kg ha⁻¹) with increased water use efficiency (5.49 kg ha⁻¹ mm⁻¹) and economic water productivity (₹ 309 ha⁻¹ mm⁻¹) over sole groundnut while other intercropping combinations failed to express. Soil moisture extraction pattern was higher at top layers and decreased with soil depth. More frequent irrigations (IW/CPE 1.0) mismatched with the crop water requirement and resulted in higher consumptive water use (500.8 mm) with moisture extraction pattern from initial layers favouring evaporation losses. At peak growth stage (60 days after sowing) higher light interception was observed in groundnut + pearl millet (41.4%) followed by castor (38.2%) combinations which was the prime reason for decreased yields as groundnut is susceptible to shading. Therefore, from the present study it could be concluded that groundnut + blackgram combination during the *rabi* season when supplied with six irrigations scheduled based on IW/CPE 0.50 at twenty days interval could significantly increase the productivity and monetary returns from the system.

Keywords: Groundnut intercropping, Irrigation Scheduling, Consumptive Water Use, Moisture Extraction Pattern, and Percent Light Interception

EFFECT OF CHEMICAL PRIMING ON INDUCING DROUGHT TOLERANCE TO RICE VARIETY CAU-R1

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Reduced moisture availability at sowing and early seedling establishment stage seriously affects seed germination, growth, and production of rainfed rice. Seed priming is currently a wide used alternate process that accelerates the germination rate and improves seedling uniformity in several crops under moisture stress condition. A pot experiment was conducted to investigate the effect of chemical priming of seeds on inducing drought tolerance to rice variety CAU-R1 during *kharif* season of 2019 at poly house of College of Agriculture, Central Agricultural University, Imphal. The experiment were laid out in Completely Randomized Design (CRD) with four replications and six treatments. Seeds were soaked in 1 % and 2 % solutions of KNO₃, CaCl₂, 40 ppm and 50 ppm of salicylic acid for 12 hours. Rice plants were induced to drought by applying mannitol solution (100mM) at 10 days after emergence (DAE) of seedlings. The results revealed that seeds priming with 2 % KNO₃ showed the lowest days to germination and days to emergence, maximum number of seedling leave, seedling height, root length, and root biomass. The treatment of 2% KNO₃ followed by 50 ppm salicylic acid were found to be superior among the other treatments in most of the parameters. Therefore, this study concludes that chemical priming of seeds with 2 % KNO₃ had significant influence on germination and all the growth parameters of rice seedlings and can be employed for better crop growth of rice.

Keywords: Chemical priming, 2 % KNO₃, Mannitol induce drought condition, Rice.

STUDIES ON PATHOGENIC VARIABILITY OF *Fusarium* species ASSOCIATED WITH WILT DISEASE OF PEA IN MANIPUR

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Fusarium wilt has been reported as one of the main causes of pea yield reduction. The study impinges to verify the virulence of all *Fusarium* isolates by performing pathogenicity test on pea to fulfill Koch's Postulates. Forty isolates of wilt infected plant of pea(*Fusarium* species) were collected from different districts of Manipur. All the isolates were identified based on the morphological characters and tested for pathogenicity test by means of rice seed inoculum techniques. Sterile distilled water was applied as a control. The appearance of disease symptom was categorized into four groups as slow pathogenic (25% wilt), moderate pathogenic (25.1 to 50% wilt), pathogenic (50.1 to 75% wilt) and highly pathogenic (75% wilt) isolates, respectively. The present findings indicated that all the isolates were found as pathogenic as compared to the control

with no visible wilt symptoms. The highest seedling mortality (100%) was found in isolates F24 and F32, followed by 80% in F1, F14, F29, F30, F31, F34, and F37 isolates. Among 40 isolates, 8 isolates showed highly pathogenic, 13 isolates as pathogenic and 14 isolates as moderately pathogenic. Six isolates viz., F6, F10, F11, F17, and F19 showed the lowest seedling mortality percentage (up to 25%) and marked as slow pathogenic. These results provide useful information on the diversity and pathogenicity of *Fusarium* species associated with wilt disease of pea in Manipur.

Keywords: *Fusarium*, Pathogenicity, Pea, Variability, Wilt.

LIMITED WATER AVAILABILITY AND ITS ADVERSE EFFECTS ON PROTEIN AND PROLINE CONTENT IN STRAWBERRY

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A study on interaction effect of Polyethyleneglycol (PEG) and varieties were evaluated to note the changes in proline and protein content of strawberry subjected to limited water availability, which is often a formidable concern in North-eastern region of India where rainfall is the only chief source of irrigation. In this experiment, three varieties of strawberry i.e. Camarosa, Festival and Winterdawn were grown in sand and coco-peat culture for 30 days to establish fully after planting and thereafter three levels of PEG viz. 0%, 20% and 40% were incorporated twice a week until 15 days to instigate drought stress and later uprooted for further analysis. Accumulation of proline is the first response of plants subjected to water stress in order to reduce cell injury. Proline accumulation is responsible for the maintenance of turgor pressure by osmotic adjustment in cytoplasm thus improving water uptake. There was a manifold increase in proline accumulation with the increase in level of stress in all the variety. However the highest accumulation was observed in Camarosa variety followed by Winterdawn and the least in Festival in both shoots and roots. Higher concentration of PEG i.e. 40% was found to have the maximum proline content. The interaction between PEG and varieties also caused a significant increase in proline level of the stressed plants depending upon the level of stress induce their different varietal characteristics. Even though proline content was increased in both shoots and roots, higher accumulation was found in shoots as compared to roots. In this experiment, protein content of both the shoot and root decreases with response to stress in all the varieties. Decline in total protein was observed to have significant variation among the treatments in both shoots and roots. Highest decline was observed in 40% PEG followed by 20% as compared to 0% PEG. Among the varieties, Winterdawn showed the highest decline in shoot and Festival showed the maximum decline in root and the least decline was recorded in Camarosa. This may be due to more protease enzyme activity in shoots of Winterdawn variety and in the roots of Festival variety which up-regulate protein breakdown and thereby resulting in the decrease amount of protein under stress conditions (Deboubaet *al.*, 2006). The interaction between PEG and varieties also caused a striking change in the protein content of shoots and roots. The interaction treatment also leads to decrease in protein content in both shoots and roots with maximum decline in Festival treated with 40% PEG followed by Winterdawn treated with 40% PEG level. Although the level of protein decreases in both shoots and roots, higher decline in the accumulation was noted in the shoots as compared to roots in this experiment.

**EFFECT OF CROP PARAMETERS OF BLACK AROMATIC RICE
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ESTABLISHMENT METHODS AND ORGANIC MANURES ON THE QUALITY**

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An experiment was conducted at College of Agriculture, CAU, Imphal, Manipur during the *Kharif* season of 2017-18 in split plot design with three replication. The treatments comprises of three crop establishment methods viz. direct seeding, normal transplanting and SRI in main plots and four nutrient management in sub plots viz. RDF, 100% RD of FYM, 100% RD of LoktakPhumdi compost and 50% RD of FYM + 50% RD of LoktakPhumdi compost. The results indicated that regarding the protein content, normal transplanting method gave higher protein (8.49%) contain among crop establishment methods which was followed by SRI and lowest in direct seeding (7.80%). Among the nutrient management practices 50% RD of FYM + 50% RD of Loktakphumdi compost recorded higher protein (8.81%) content which was followed by RDF. The lowest protein content (7.94%) was obtained with the application of 100% RD of FYM. Increasing the levels of nutrients also increases the protein content in grain. The highest protein concentration in the grains was obtained in response to the combined application of the highest rates of the organic fertilizer after long term experiment. It may be due to higher supply of nitrogen which increases the protein (%) in rice grain. Quality parameters viz. amylose, starch and anthocyanin content highest in the combination of organic manure i.e. 50% RD of FYM + 50% RD of Loktakphumdi compost (21.51% ,76.98% and 233.55 mg/100gm) and lowest (21.21% , 73.91% and 216.92 mg/100gm) in the chemical treatment plot i.e. RDF. Grain quality has also been changed for the worst due to excess and imbalance use of chemical fertilizers. Management of organic nutrient seem to be more appropriate due to increase grain quality as organic manures, particularly FYM and compost not only supply macronutrient but also meet the requirements of micronutrients, besides improving soil health. But regarding the crop establishment methods and interaction effect found to be non-significant.

Keywords: Establishment methods, organic manures, quality parameter

**POST-HARVEST PROCESSING AND AGRITOURISM FOR VALUE ADDITION OF
DRAGON FRUIT (*Hylocereusundatus*)**

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Dragon fruit or Pitahaya (*Hylocereusundatus*) also known as “The Wonderous Fruit” of the 21st century belongs to Cactaceae family and is known to be originally native to a region including

Mexico, Guatemala, Nicaragua, Costa Rica, El Salvador and northern South America. Its cultivation is widespread in Southeast Asia, Florida, the Caribbean and subtropical world region. Although it is commercially cultivated in other countries, it has not attained commercial cultivation status in India. It is one of the newly emerged fruit crop in India. They are packed with vitamins and minerals and are also a rich source of antioxidants. They are used in controlling cancer and diabetes, lower cholesterol levels and blood pressure, prevent arthritis and also fight against ageing. With the gaining consciousness about health and healthy lifestyles, people are changing their food habits towards fresh and nutritious fruits products. Value additions of the products are done to supply wholesome, nutritious, acceptable and safe food products to meet the consumer's requirement and also minimize waste disposal and perishability of the fruits. Dragon fruit can be processed into energy and fruit bars, ice cream, jelly, marmalade and preserves, juice, pastries, pulp, and yogurt. The juice extracts of red fleshed varieties can be used as a dye and a natural food colorant. Dried peel can also be used to extract pectin and antioxidants. It also has wide uses in cosmetics industries such as to prepare lip balm, foot and body scrub and face cream. Another way where value can be added when producing a crop such as dragon fruit is "Agritourism". Agritourism is a commercial enterprise at a working farm or ranch conducted for the enjoyment and education of visitors, and that generates supplemental income for the owner or operator" according to the University of California Cooperative Extension. The visitors can enjoy and strengthen the atmosphere of the agricultural life, while the entrepreneurs can increase their income by providing touristic services, remaining in the business and creating additional employment. In this aspect the agricultural heritage is preserved, and the economic condition of the locals is improved. Agritourism can also be considered as "a sustainable strategy: in its stated objectives, it promotes the conservation of a broadly conceived rural environment through its socio-economic development". It can be regarded as the "missing link" in standard territorial arrangements that amalgamates agricultural, tourist, environmental, cultural and historic resources.

DEVELOPMENT OF RECOMBINASE POLYMERASE AMPLIFICATION (RPA) BASED ISOTHERMAL METHOD FOR ROBUST DIAGNOSIS OF *CHILLI VEINAL MOTTLE VIRUS*

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Among viral diseases of kingchilli, *Chilliveinal mottle virus*(ChiVMV), a member of the genus *Potyvirus* of the family *Potyviridae* is considered as the major constraint in the production of kingchilli in North-East (NE) India. The king chilli of NE is most susceptible to this disease and infection up to 100% has been found in many parts which lead to no production at all. The present study reports development and standization of an isothermal based recombinase polymerase amplification (RPA) assay for a quick, highly specific, and sensitive technique for the detection and diagnosis of ChiVMV in kingchilli samples. A pair of ChiVMV specific RPA primers were designed based on the conserved region of ChiVMV coat protein gene to utilize for both RT-RPA as well as polymerase chain reaction (PCR). Our result showed that the RPA method can be performed at a 40 minute incubation period with 38⁰ C to detect the virus. Comparative evaluation

of RT-RPA and PCR based assays were done using complementary DNA (cDNA) and plant crude sap as a template. ChiVMV infection was efficiently detected from the crude sap in RT-RPA when compared with the regular RT-PCR. RT-PCR was validated using field samples of kingchilli collected from different parts of North-East India by using cDNA and crude sap extracts. our study showed that RT-RPA can be successfully adopted as a substitute to PCR for the detection of ChiVMV infecting kingchilli.

Key Words: Kingchilli, *Chilliveinal mottle virus*, Recombinase polymerase amplification

A REVIEW ON SMART IRRIGATION SYSTEM FOR SUSTAINABLE AGRICULTURE IROM RATI CHANU¹

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Water scarcity is one of the major problem that is rising rapidly in the world. It leads to drought, food scarcity, less in crop production which have impact on agriculture. In order to solve this problem, Smart Irrigation system is required that uses water judiciously and also important for farming practices. It provides attractive instruments and methodologies for saving water, improving soil as well as better crop yield. It controls over watering, excess runoff and soil erosion. Major step towards sustainable smart irrigation system is to accomplish high water use efficiency (WUE). To promote the use of such technologies, the landscape services industry has introduced for the integration of local weather data into irrigation controller systems or mobile phone control and alert notifications that help to facilitate usability and prevent over-irrigation. IoT is practiced by installing sensors in the crop field to monitor the soil temperature and soil moisture which transmits the data to the micro controller for estimate of water demands of plants. Some of the devices are- Moisture Sensor (measuring moisture content), DHT11 Sensor (measuring temperature and humidity level), NODEMCU (convert analog to digital signal), SERVO MOTOR (operating ON and OFF), CLOUD (receive signals and to retrieve back),etc. Among the different methods of irrigation, Alternate Wetting and Drying(AWD) Irrigation System is a smart irrigation system, developed by IIRI in partnership with national agricultural research agencies in many countries. It can save water requirement up to 20-50% and improve WUE besides reducing greenhouse gas emissions by 30-50%, released by flooding of rice. Thus, Smart Irrigation System is essential to farmers all over the world in order to produce more in quantity with less amount of water.

Keywords: Smart Irrigation, WUE, IoT, AWD

NEWER WEEDICIDE FOR DRUM SEEDED RICE: AN EVALUATION STUDY

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Field experiment was conducted at Agricultural College and Research Institute, Killikulam during *Late Pishanam* season (November- March) of 2016 - 2017 to evolve suitable weed management practices for direct sown drum seeded rice in Thamirabarani command area. The experiment was laid out in a randomized block design with three replications. It consisted of twelve treatments viz., T₁- PE pretilachlor @ 750 g a.i. ha⁻¹ (PEP) + one cono-weeding (CW), T₂ - PEP + POE

azimsulfuron @ 30 g a.i. ha⁻¹ (POEA), T₃ - PEP + POE bispyribac sodium @ 25 g a.i. ha⁻¹ (POEB), T₄ - PE anilofos @ 375 g a.i. ha⁻¹ (PEA) + one CW, T₅ - PEA + POEA, T₆ - PEA + POEB, T₇ - PE pendimethalin @ 1000 g a.i. ha⁻¹ (PEPN) + one CW, T₈ - PEPN + POEA, T₉ - PEPN + POEB, T₁₀ - Two CW on 15 and 30 DAS, T₁₁ - Farmer's practice (Hand weeding twice on 15 and 30 DAS) and T₁₂ - Un-weeded control. Rice ASD 16 was used as a test variety. Among the various weed management practices, higher grain yield of 6680 kg ha⁻¹ was obtained with the adoption of farmer's practice (hand weeding twice on 15 and 30 DAS). This was comparable with the application of pretilachlor @ 750 g a.i. ha⁻¹ on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha⁻¹ on 30 DAS as POE with a grain yield of 6460 kg ha⁻¹. The same trend was observed in straw yield also. Higher nutrient uptake was also obtained with these treatments. From the above results, it could be concluded that application of pretilachlor @ 750 g a.i. ha⁻¹ on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha⁻¹ on 30 DAS as POE was found to be the viable weed management practices for direct sown drum seeded rice in Thamirabarani command area, Tamil Nadu to realise higher net returns through higher yield.

Key Words: Drum Seeded Rice, Chemical Weed Management, Pendimethalin, Bispyribac sodium, Pretilachlor, Azimsulfuron, Cono-weeder

ASSESSMENT OF SOIL PH, EC AND OC IN DIFFERENT LAND USE SYSTEMS OF DODA DISTRICT, J&K, INDIA

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The present study was undertaken to assess the status of soil pH, EC and OC in one hundred and eighty soil samples collected from different land use systems of district Doda. A soil survey was conducted to assess soil pH, EC and OC. Composite surface soil samples were collected using stratified random sampling method at a depth of 0-15 cm from Agriculture, Barren lands and at a depth of 1 metre from Forest, Horticulture of district Doda. The exact sample location was recorded using a handheld GPS receiver. Geographic Information System (GIS) and Inverse distance weighting (IDW) technique was adopted to generate prediction maps of these soil properties. Soil pH was moderately acidic to slightly alkaline, EC was (<1dS/m) indicated non-saline condition which is safe for plant growth and development. Organic carbon content was moderate to high ranged from (0.5-1.00 %). Maximum soil pH was recorded under barren land (7.90) followed by agriculture (7.55), horticulture (7.30) and forest (7.21). The Electrical Conductivity under different land use systems ranged from 0.08-0.31 dSm⁻¹ under forest, 0.18-0.77 dS m⁻¹ under barren land, 0.11-0.45 dSm⁻¹ under agriculture and 0.10-0.35 dSm⁻¹ under horticulture, respectively. The maximum OC was recorded under forest (1.19 %), followed by horticulture (0.97 %), agriculture (0.87 %) and barren land (0.65 %) respectively.

Key Words: Barren land, Electrical Conductivity, IDW, GIS and Land use systems

PHENOLOGICAL CHARACTERISTICS OF CHIRONJI (*Buchananialanzan*) FRUITS AT CHOTANAGPUR PLATEAU REGION

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Chironji, Char or Achar (*Buchananialanzan* Spreng; family Anacardiaceae) is an important non – wood tree species found in deciduous forests throughout the greater part of India. In central India, it is a common associate of teak, sal and mixed forests. It is a small to moderate sized tree, generally attaining a height up to 18 m and girth 1.5 m. The bark is dark gray or black, regularly divided into small rectangular plates, somewhat resembling a crocodile hide and reddish inside.

ECO-FRIENDLY MANAGEMENT OF FUSARIUM WILT OF TOMATO- AN OVERVIEW

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Tomato (*Lycopersicon esculentum*) is economically the most important and popular fresh market vegetables throughout the world. It is a warm season crop and highly affected by adverse climatic conditions. Tomato production is facing many biotic and abiotic threats, among them biotic diseases constitute the most important factor that reduce average yield. Fusarium wilt of tomato caused by *Fusarium oxysporum* f.sp. *lycopersici* known as one of the most devastating disease of tomato worldwide. It causes serious yield reduction of 10 to 50% leading to severe economic losses. Fusarium is an important soil inhabiting fungi and most of its strains assigned are saprophytic or non-pathogenic. Pathogenic fungi of the genus *Fusarium* that are the causal agents of tomato wilt which cause root and basal stem weakening and resulting in the wilting of plants. Browning of the vascular tissue is strong indication of Fusarium wilt. It poses a greater problem in management by using fungicides which are uneconomical and non-biodegradable, development of fungicide resistance in pathogens and indiscriminate use often leads to several problems to human and animal health. This consequence, therefore, calls for alternative approaches for the management of *Fusarium* wilt of tomato by using natural products like botanical amendments or botanical extracts and bio-control agents, due to their less negative impacts on the human and environmental health hazard which is eco-friendly. Ecofriendly management has been reported to improve plant growth parameter and suppress the attack of pathogens caused by them leading ultimately to improved crop yield.

Keywords: Biocontrol, Fusarium, Tomato, Wilt

EFFECT OF NITROGEN LEVELS AND CATTLE URINE FOLIAR SPRAYS ON YIELD AND ECONOMICS OF MAIZE (*Zea mays* L.)

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A field experiment was conducted to assess the effect of nitrogen levels and cattle urine foliar sprays on yield and economics of maize (*Zea mays* L.) at Agronomy Farm, College of Agriculture, Pune, during *Kharif*- 2019. The experiment consisted of 16 treatment combinations based on four levels of the recommended dose of nitrogen (@ 0, 50, 75 and 100%) through urea and four levels of cattle urine foliar spray (@ 0, 5, 10 and 15%) taken at 25, 45 and 60 DAS replicated thrice in Factorial Randomized Block Design. The results revealed that the grain and stover yield of maize were influenced significantly and the statistically higher grain and stover yield was recorded with the application of 100% RDN (120 kg ha⁻¹). While the application of 10% cattle urine sprays recorded the statistically higher grain and stover yield which was followed by 15% cattle urine spray. In respect to the economics of maize, higher gross monetary returns, net monetary returns and B:C ratio was recorded with the application of 100% RDN whereas, the application of 10% cattle urine spray recorded statistically higher net monetary returns, gross monetary returns and B:C ratio followed by 15% foliar spray of cattle urine.

Key Words :Maize, Nitrogen levels, Cattle urine sprays, yield and economics

RESPONSE OF BIOLOGICALLY SYNTHESIZED ZNO NPS ON MAIZE GROWTH

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A field experiment was conducted during summer season of 2019 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to study the "Response of biologically synthesized ZnO nanoparticles on maize growth". There were thirteen treatment combinations consisting of two zinc application methods through seed priming and foliar spray at 500, 1000 and 2000 ppm. Almost all the growth attributes *viz.* plant height, number of leaves plant⁻¹ and leaf area were significantly affected due to also zinc application method, source and levels, however significantly higher growth attributes were recorded by application of foliar spray of 1000 ppm ZnO NPs.

Keywords: Maize, NPs, Zinc, Growth.

EFFECT OF DIFFERENT DOSES OF EMS ON GERMINATION AND MORPHO-PHYSIOLOGICAL CHARACTERISTICS OF SUNFLOWER SEEDLING

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The response of sunflower variety BARI Surjamukhi-2 (*Helianthus annuus* L.) to different concentration of Ethyl-Methane Sulphonate (EMS) at germination, survival and early seedling growth was investigated to determine the appropriate EMS dose for obtaining desirable sunflower mutant. A total of ten seeds were treated with each of a series of seven different concentrations of EMS viz T1:0% (control), T2:0.2%, T3:0.4%, T4:0.6%, T5:0.8%, T6:1.0% and T7:1.2% and plated on Petri dish for germination. At the 7 days of germination it was found that germination % was decreased with the increasing dose of EMS for all the treatment compared to control, except for T4:0.6% treatment where a 100% seed was found to be germinated. Survivability % was recorded at 7 days interval up to 30 days and it was found that at least 50% seedlings were survived at the dose of T4:0.6% up to 30 days but a decreasing trend was observed in the subsequent doses at this stage. After 7 days of emergence, each germinated and non-germinated seeds were sown in a single poly bag and maintained for 30 days. The observations were recorded on number of leaves, leaf area, SPAD value, number of internodes, internode length, shoot and root length, fresh and dry weight of leaf, fresh and dry weight of shoot and fresh and dry weight of root. From the result, significantly gradual decreasing trend was observed with the increasing dose of EMS compared to control for most of the cases. Based on regression analysis, using shoot length data, optimum dose of EMS concentration was found 0.6% which would be the best concentration for sunflower mutagenic agent.

Key words: Sunflower, EMS, dose, germination, morpho-physiological characters

DEVELOPMENT OF SPECIES-SPECIFIC MARKERS FOR THE DETECTION AND DIFFERENTIATION AMONG *VENTURIA* SPECIES CAUSING SCAB ON ROSACEOUS HOST PLANTS

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The genus *Venturia* is comprised of 290 species, among which some species are agriculturally important and cause enormous loss to pome and stone fruits i.e. rosaceous host plants. The most

important *Venturia* spp. are *V. inaequalis* (apple scab), *V. pyrina* (pear scab), and *V. carpophila* (peach and almond scab). Species characterization in the genus *Venturia* is difficult based on morphological characters and due to slow growth on culture medium. It is necessary to develop highly sensitive and robust PCR molecular markers to detect and differentiate the important *Venturia* species. In the present investigation, number of primers were designed from the available genomes of *V. inaequalis*, *V. pyrina*, and *V. carpophila*. Many primers showed cross transferability justifying that 90% genomes of various *Venturia* species similar, one species may have sex on other host as previously described for apple scab and pear host and a few did not yield any PCR product. Three primers specific to each *Venturia* spp. are able to detect the pathogen infection in the leaves infected with scab. The primer sets developed in the present investigation are able to detect the three *Venturia* spp. simultaneously in a multiplex PCR. The present study is of its first kind wherein species-specific primers were developed for three important *Venturia* spp. Our primer set simultaneously detect *V. inaequalis*, *V. pyrina*, and *V. carpophila* in a single multiplex PCR. The scientific community across the world can exploit the specific primers for the early scab infection and species identification.

Key words: Scab, PCR based detection, *Venturia* species, Differentiation, Diagnosis

WATER QUALITY AND CONSERVATION STATUS OF MONOMIC TIC LAKE OF KASHMIR HIMALAYA, INDIA

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In fresh water ecosystems, water quality plays an important role in determining the status and condition of that fresh water ecosystem. During the present study, an attempt was made to assess the water quality and conservation status of Manasbal Lake of Kashmir Himalaya. The Manasbal Lake, a marl lake, is located district Ganderbal in the UT of Jammu and Kashmir, India. The actual location of the Manasbal catchment is defined by latitudes 34^o14' - 34^o16' N and longitude 74^o40' - 74^o43' E, and has altitude position of about 1551m a.s.l. The lake catchment covers an area of about 22 km² located in district Ganderbal at a distance of 30 km north from the Srinagar city of Jammu and Kashmir. The Manasbal Lake a semi urban lake was getting modified as a result of cultural eutrophication due to anthropogenic pressure, siltation and the waste water released from the nearby kilns and residential areas. From the present study, it can be concluded that the higher values of Phosphates (PO₄), Alkalinity, Hardness, Electric Conductivity, Free carbon dioxide and lower values of dissolved oxygen and transparency clearly depicted higher trophic status of Manasbal Lake. It can also be concluded that climatic factors, untreated sewage and solid garbage from surrounding population, fertilizers containing Nitrates and Phosphates and slit load were the main causes for degradation of water quality of the studied lake. Hence, periodic monitoring of Manasbal Lake is necessary for assessing the quality of water for human and animal consumption as well as for aquatic life. Besides, immediate remedial measures should be taken up for protection and conservation of this monomictic lake in order to save it from further pollution and deterioration.

Key words: Monomictic, Manasbal Lake, Anthropogenic pressure, Cultural eutrophication, Physico-chemical parameters.

VARIATION IN ZOOPLANKTON DIVERSITY OF KALISARAR DAM OF GONDIA DISTRICT (M.S)

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Zooplankton assorted variety mirrors the nature of water thus establishes the significant environmental boundary to survey it. These are valuable as bioindicators, but at the same time are useful for enhancing dirtied waters. Zooplankton people group is cosmopolitan in nature and they live in all freshwater living spaces of the world. Zooplankton is the momentary connection among phytoplankton and fish. They are acceptable markers of the adjustments in water quality since they are emphatically influenced by ecological conditions and react rapidly to changes in water quality. Henceforth subjective and quantitative investigations of zooplankton are vital. In the current paper subjective and quantitative investigations of zooplanktons in Kalisarar dam of Gondia locale were completed during June 2018 to May 2019. Utilizing minute investigations of zooplankton, this examination uncovered that 11 genera having a place with five significant gatherings for example Cladocera (two genera), Copepoda (three genera), Ostracoda (one class), Protozoa (two genera) and Rotifera (three genera) were available.

Keywords: Zooplankton, Kalisarar dam, Gondia district

RELEVANCE OF WOLBACHIA IN BIOCONTROL OF INSECT PESTS NEERU DUMRA¹, KRISHNA ROLANIA², SACHIN KUMAR³

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Wolbachia is a gram-negative, obligatory bacterial endosymbiont that is extremely widespread among arthropod organisms, and has attracted significant attention due to its potential for insect control and vector-borne disease suppression. With the resurgence of vector-borne disease, some have been pessimistic about the effectiveness of conventional control measures, such as long-term insecticides. In addition, increased use of insecticides has given rise to questions about adverse environmental impacts. Therefore, the need for innovative environmentally friendly management methods to supplement existing insect control initiatives has been suggested. For these reasons, there is increasing interest in the possible application of Wolbachia in biocontrol programmes, either to increase biocontrol agent populations or to reduce pest species populations. Wolbachia manipulate host reproduction to promote their own spread and maintenance in host's populations by a number of phenotypes. The use of Wolbachia in biocontrol work would be influenced by simple manipulation. Manipulations involve the elimination, transfer, or modification of genes. Infections may be removed by applying antibiotics (e.g. rifampicin, tetracycline) to an arthropod host's larval diet or adult feeding stages. In a changed method, Wolbachia was removed by adding rifampicin in the diet of the *Drosophila* host wasp in a parasitoid wasp. Elimination can also be accomplished by rearing hosts at high temperatures, or rearing hosts under crowded conditions. Yet therapies to remove Wolbachia can also kill bacteria other than Wolbachia. The loss of these latter species, depending on their position in the host arthropod, may or may not be of concern; for example, nutritional symbiont versus pathogen. (Robert et al., 2012). Field populations of major crop insect, African army worm (*Spodoptera exempta*), showing a positive correlation between the prevalence

and severity of nucleopolydovirus (SpexNPV) infection and three strains of Wolbachia. Laboratory bioassays have shown that infection with one of these strains, a male-killer, increases SpexNPV host mortality by 6–14 times. Instead of protecting their lepidopteran host from viral infection, these studies have shown that Wolbachia makes them more vulnerable and potentially has consequences for the biological control of other insect pests. Wolbachia strains are infected with at least 46 per cent of these pest and beneficial species. Many biocontrol research programs therefore include Wolbachia as a component although their presence may be unsuspecting. Arthropod monitoring for infection can be done readily using PCR techniques and specific primers of Wolbachia.

Key words: wolbachia, endosymbiont, insect

FIELD SCREENING OF BRINJAL CULTIVARS AGAINST THE MEALYBUG, *Coccidohystrixinsolita* (GREEN) AND IT'S NATURAL ENEMIES

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The brinjal mealybug, *Coccidohystrixinsolita* (Green), hitherto known as a minor pest acquired the status of an economically important pest infesting brinjal in Kerala. The management of mealybugs is a tedious task due to its cryptic nature, waxy coating over the body and development of resistance to insecticides. Repetitive application of synthetic chemicals led to the development of insecticide resistance, environmental hazards and adverse effects on the population of natural enemies. In this context, an ecologically safe approach is need of the hour which highlights the significance of adoption of host plant resistance as a management strategy.

So a field experiment was conducted in randomized block design with 10 cultivars each with three replications at College of Agriculture, Vellayani, Thiruvananthapuram during 2018-19. The mealybug population was taken by adopting window method by counting the nymphs and adults from the top, middle and bottom leaves of five randomly selected plants. The % leaf infestation was computed along with population of natural enemies in terms of coccinellids and spiders/ plant with the mean population calculated from five selected observational plants/ replication. The data were subjected to square root transformation and analyzed statistically by using WASP software and the means were separated by Duncan's Multiple Range Test (DMRT). Among the tested cultivars, PusaUttam recorded the lowest mean population of mealybugs (38.58) which was statistically on par with Pusa Purple Long (41.67). The hybrid cultivar, Udit harbored the highest number of mealybugs (127.58) which was statistically on par with Pink Long (116.75) and Haritha (115.50). The tested brinjal cultivars were categorized into groups based on mean % leaf infestation caused by *C. insolita*. Among the tested cultivars, Pusa Purple Long was included under the category resistant whereas PusaUttam and Ponni were in the group moderately resistant. Pusa Kaushal, PusaShyamla and Neelima were fall under the group moderately susceptible whereas hybrids Green Long and Pink Long under susceptible category. The cultivars Haritha (3.917) and Udit (2.083) attracted more number of coccinellid beetles whereas highest mean population of spiders were observed in Pusa Purple Long (1.417).

Keywords: *Coccidohystrixinsolita*, brinjal cultivars, tolerance index, host plant resistance

A STUDY TO EVALUATE THE EFFECT OF VARIOUS SUPPLEMENTING MATERIALS ON THE YIELDS OF OYSTER MUSHROOM (*Pleurotussajor-caju*) (Fr.) Singer IN ARUNACHAL PRADESH

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The data showed that the days taken for spawn running or complete colonization of the substrate by the fungus were similar in all the four treatments of substrate taking 11 days. However, pinhead formation in paddy straw and paddy straw supplemented with *Bauhinia variegata* (NS) in the ratio of 4:1 and paddy straw supplemented with 0.5% urea took similar time of 3 days followed by a slightly delayed pinhead appearance taking four days paddy straw supplemented with 0.5% SM (Soyabean Meal). The flush duration was also equal in PS (Control) and paddy straw supplemented with *Bauhinia variegata* taking 7 days each and slightly earlier in paddy straw supplemented with soyabean meal taking 5 days and paddy straw supplemented with urea took 7 days.

From the study, it was observed that *Pleurotussajor-caju* gave almost equal yield on paddy straw supplemented with urea@0.5% with an average yield of 191.7(g) per bag followed by paddy straw supplemented with 0.5% Soybean Meal with average yield of 183.7(g) and paddy straw supplemented with *Bauhinia variegata* (NS) @ 4:1 ratio with nearly equivalent average yield of 182.14 g per bag. Statistical Analysis by ANOVA single factor showed that the yield of all the three treatments are non-significant at $P < 0.05$ level. The three substrate treatments used in the study were found to be slightly superior yielding than untreated paddy straw as substrate (Control) with a lesser and average yield of 155.6(g) per bag and statistical analysis also showed significant variation at $P < 0.05$ level proving that paddy straw supplemented with 0.05% soybean meal, paddy straw supplemented with 0.5% urea and paddy straw supplemented with *Bauhinia variegata* @4:1 are superior yielding than untreated paddy straw and hence these are experimentally proved to be better substrate for mushroom yield of *Pleurotussajor-caju*.

The statistical analysis of biological efficiency (%) per bag of the different substrate treatment by ANOVA Single factor showed significant difference of untreated paddy straw with respect to the rest of the substrate treated with 4:1 *Bauhinia variegata*, 0.5% urea and 0.5% soybean meal. Untreated paddy straw with least biological efficiency of 51.348 proved inferior to rest of the treatments which were equivalently colonized and degraded by the fungus giving better yields.

Implications

Bauhinia variegata (L.) Benth., an semi-evergreen legume tree largely planted for beautification and landscaping for its attractive, decorative floral morphology having no significant other commercial applications except for a few reports of its young shoots and buds being consumed as culinary purpose. Like any other nitrogen rich plant based materials, the leaf biomass used in the present study proved that this particular plant resource can also be employed as a cheap, readily available, superior quality nitrogen supplementing material which is a highly efficient yield enhancing natural, organic based nitrogen supplementing material in oyster mushroom cultivation to boost the mushroom harvests as shown in the yields of *Pleurotussajor-caju* (PL-1140) in the present study.

Keywords: *Pleurotussajor-caju*, supplementing materials, mushroom yields

ROLE OF SOCIAL MEDIA IN MARKETING OF AGRICULTURAL PRODUCE IN PRESENT PANDEMIC SITUATION OF COVID-19 IN INDIA

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Social media is the new platform in marketing of agricultural produce of Present Pandemic Situation of COVID-19 in India that has blogs, micro blogs, pages, groups etc. This study adopted a descriptive research and the primary data collection tools were structured questionnaire and in depth interviews from farmers who uses social media. From the analysis it is found that social media is very useful tool in agricultural marketing. It saves both time and cost of the farmers for getting information. Face book is the most likely social media for pages and profiles. YouTube videos are most popular for information getting with applications. WhatsApp is the handy use of social media and mostly preferred for related groups. Many officials are having their official pages, blogs, and groups on social media and it helps in getting information and solving the problems. Challenges were adoption of social media as tool of marketing. People are relatively less-trusted on e-buying, e-selling of agricultural commodity on social media in the study area.

Keywords: COVID-19, Social media, agricultural marketing, Information and Communication Technology (ICT), Farmers.

EFFECT OF COW DUNG SMOKE ON MORTALITY OF PULSE BEETLE, *Callosobruchus chinensis* (Linn.) AND QUALITY PARAMETERS OF STORED PULSES AT PANTNAGAR, UTTARAKHAND

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A bioassay study was conducted on the effect of cow dung smoke on mortality of pulse beetle, *Callosobruchus chinensis* (Linn.) and on quality parameters of stored pulse commodities viz. mung bean, urd bean, chickpea and pigeonpea under laboratory conditions in the Department of Entomology, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand during 2018. To avoid the injudicious use of synthetic chemicals, the naturally produced smoke was used for eco-friendly management of pulse beetle in stored pulses. The results showed that more than 50per cent insect mortality was observed on pulse seeds after 96h to 120 h of exposure to cow dung smoke whereas without smoke the overall mean mortality of pulse beetles was 2.22, 4.99, 6.94 and 11.38 after 48, 72 h 96h and 120h, respectively of insects confinement under airtight conditions on different pulse commodities. The data clearly showed that the overall mean mortality of pulse beetle on different stored pulses was increased to four times with smoke treatments at different interval of exposure periods. On the other hand, cow dung smoke had no adverse effect on different quality parameters of seeds after different exposure time periods which clearly depicted that the overall mean germination of pulse commodities was not affected by smoke exposure from 1h to 120h of time interval as it was ranged from 85.83 to 87.91 with germination index (7.35 to 7.53), root length (13.20cm to 14.23cm), shoot length (12.81 to 13.75), vigour index (2289.11 to 2429.66), significance of viability (0.97 to 0.99) which was quite similar to the overall mean values per cent

germination (87.91) germination index (7.53), root length (13.80cm), shoot length (13.75cm), vigour index (2423.33) and significance of viability (1.00) as observed in untreated pulses commodities. Therefore, the present study clearly revealed that cow dung smoke can easily be incorporate in safe storage system as it was found lethal to pulse beetle with no any deleterious effects on seed quality of pulse commodities under storage conditions.

Keywords: *Callosobruchus*, Cow dung , pulse beetle, stored pulses, smoke

IMPROVING AGRICULTURAL WATER USE EFFICIENCY BY NUTRIENT AND WATER MANAGEMENT

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Agriculture accounts for around 70% of global freshwater withdrawals reaching up to 90% in some fast-growing economies. The world's population is presently experiencing a period of unprecedented growth and is expected to increase from 7.6 billion in 2017 to between 9.4 and 10.2 billion by 2050. To meet their water requirements for domestic, industrial and agricultural purposes, increasing the water use efficiency seems to be the only viable way. Agriculturists should focus on increasing water use efficiency to the highest level as this sector is responsible for the maximum use of water. Proper plant nutrient management is a good strategy to enhance water use efficiency and productivity in crop plants. Plant nutrients play a very important role in enhancing water use efficiency under limited water supply. The proper management of macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium), micronutrients (zinc, boron, iron, manganese, molybdenum, chloride), and silicon (a beneficial nutrient) play a vital role in enhancing water use efficiency in a crop plant. Again besides the nutrient management agriculturalists will need to exercise flexibility in managing the rate, frequency, and duration of water supplies to successfully allocate limited water and other inputs to crops. The most effective means to conserve water appears to be through carefully managed deficit irrigation strategies that are supported by an advanced irrigation system and flexible, state-of-the-art water delivery systems. Hence, a significant increase in water use efficiency can be achieved by the judicious use of nutrients and water to optimize their efficiency.

Keywords: Water use efficiency, Nutrient management, Macro and micronutrients, Agriculture, Deficit irrigation strategies.

EFFECT OF CLIMATE CHANGE ON AGRICULTURE AND IT'S MITIGATION

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Climate change is considered one of the major environmental problems in the 21st century which has become an important scientific and political issue. Inter-Governmental Panel on Climate Change has shown that the earth's temperature has increased by 0.74°C between 1906 and 2005 due to an increase in anthropogenic emissions of greenhouse gases. These changes may culminate in an

adverse impact on human health and the biosphere on which we depend. The multi-faceted interactions among the humans, microbes and the rest of the biosphere, have started reflecting an increase in the concentration of greenhouse gases (GHGs) i.e. CO₂, CH₄ and N₂O, causing warming across the globe. Agriculture is likely to suffer due to increased temperature, drought, erratic weather, pests and diseases, etc. Constructive debate on agriculture and climate change is hampered by a false dichotomy between food security and environmental health. It can both contribute to mitigation and sequestration of carbon emissions and accounting for agriculture's carbon footprint is necessary, particularly if agriculture is included in greenhouse gas reduction commitments. Policies also will play a role in enhancing the ability of agriculture to adapt and mitigate climate change, while also contributing to other environmental goals. However, there are a lot of uncertainties about the assessment of impact, adaptation and mitigation of climate change in agriculture. There is a need to develop and apply a standard methodology across the board for various studies related to climate change and agriculture.

Keywords: Climate change, Greenhouse gases, Agriculture, Carbon footprint, Adaptation and mitigation etc.

ECONOMIC ANALYSIS OF CULTIVATION TECHNIQUES OF WHEAT IN HARYANA

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The study was conducted in Karnal district of Haryana in 2019-20. The district of Haryana was selected purposively on the basis of the highest area under different types of resource conservation cultivation techniques under wheat crop. A comparative analysis on the total cost of cultivation and its implication on conventional technique (CT), zero tillage tillage technique (ZTT) and turbo happy seeder technique (THST) have been done. The results revealed that per acre total cost of cultivation technique of wheat in conventional technique of wheat (CT) found to be higher Rs 40219.28 compared to zero tillage technique (ZTT) Rs 37515 and turbo happy seeder technique (THST) Rs 36540.83. It was found that per acre gross returns was found to be higher in turbo happy seeder technique (THST) of wheat Rs.44205.88 compared to conventional technique (CT) and zero tillage technique (ZTT) i.e. Rs.43398.63 and Rs.42127.75 respectively. This is because of yield of wheat is slightly more in case of turbo happy seeder technique as compared to conventional and zero tillage technique. While net returns were estimated to be higher in case of turbo happy seeder technique of wheat i.e. Rs.7665.05/acre as compared to zero tillage technique (ZTT) and conventional technique (CT) i.e. Rs.4612.34/acre and Rs. 3179.35/acre respectively. The reason behind the higher net returns in zero tillage technique was due to the lower cost of wheat cultivation as compared to conventional technique. The results revealed that problem of weed infestation, less effective Weedicides, non adoption of seed treatment, non adoption of recommended doses of fertilizers and high cost of potashic fertilizers as major constraints which were inhibiting the production as well as profitability of conventional technique of wheat in Haryana. By overall economic analysis of cultivation techniques of wheat, Turbo happy seeder technique (THST) was found efficient & significant for farmers as compared to zero tillage technique (ZTT) and conventional technique (CT).

Keywords: Analysis, Cultivation, Economic, Technique, Wheat

ASSESSMENT OF SOME INSECTICIDES AGAINST FRUIT BORER OF LADYFINGER

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Evaluation of some insecticides Indoxacarb, Deltamethrin @ 50 g/ha and combination with neem oil, Prophenophos+ Cypermethrin @ 550 g/ha was evaluated along with some insecticides viz, diamethoate @400g /ha, cypermethrin 500g/ha and neem product neem gold 5 g/ha against fruit borer of *Eariasspcies*. and leaf folder *Sylepta derogate* of ladyfinger. The result revealed that significantly better management of fruit borer and leaf folder were obtained with application of prophenophos, cypermethrin and prophenophos+ Cypermethrin. The decrease in per cent fruit borer infestation with these three treatments ranged from 67.7-77.5. The healthy fruit yield recorded significantly the highest (55-57.0 q/ha) with these three treatments over another treatments and control (45.35 q/ha) the percent increase yield in fruit yield was the highest 23.5% with prophenophos + cypermethrin over control.

GENETIC VARIABILITY IN MORPHO -PHYSIO – BIOCHEMICAL AND QUALITY TRAITS IN INDIAN MUSTARD GENOTYPES UNDER RAINFED MOISTURE STRESSED CONDITION

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The present study was undertaken in Randomized Complete Block Design (*Rabi* 2016-17) in three replications with 20 genotypes, under four environments viz, no irrigation(E_1) under Rainout Shelter, rainfed(E_2), one irrigation(E_3) and two irrigations(E_4); evaluated thirty – three morpho-physio-biochemical traits, respectively along with laboratory experiment for drought related thirteen physiological traits is aimed to identify the trait combination in genotypes for moisture stressed condition as *Brassicac*s predominantly occupied in rainfed condition and now the situation demands for such crop species acclimatization in changing climatic scenario.Genotypes studied exhibited significant variability under all the four environments (E_1 , E_2 , E_3 and E_4) for DFFO, DPM, DCF, PBP⁻¹, SBP⁻¹, NSPM, LPMA, SS⁻¹, RL, SLW, LMSI, RWC, ELWL, CA, PERO, BY, HI, DME, GY ha⁻¹ and OY ha⁻¹ whereas, HFPB exhibited significant variability among studied genotypes in E_1 , E_2 and E_3 and for root mass in E_1 , E_2 and E_4 . The analysis of variance pooled over environments ($E_1 + E_2 + E_3 + E_4$) for morpho- physio-biochemical and quality characters exhibited significant variability for all the studied traits except those 9 traits (SD, LS, LAI, CC, DTI, SI, PRO, TSW and OC) which have not expressed variability among themselves.Characters, with high mean and wide range of variability were HFPB, SBP, RL, SLW and BY indicated usefulness of traits for selection.The genotypic coefficient of variation estimates had close agreement with phenotypic coefficient of variation estimates indicated that meagre influence of environment over these traits. Wide variation in different proportion was observed for traits namely, DCF, DPM, TSW, DTI, SI, BY, HI, DME, OC, GY and OY indicating moderate to high influence of environments.High heritability coupled with high genetic advance was observed for all the environments (E_1 , E_2 , E_3 and

E₄) for Height of first primary branch, Primary branches per plant, Secondary branches per plant, Specific leaf weight and Catalase activity, indicated that greater contribution of additive genetic component. The most promising genotypes which have reflected superiority in component traits in all individual environments (E₁, E₂, E₃ and E₄) as well as across environments were Rajendra Suphlam (24 traits) followed by Rohini (for 14 traits) ; NRCDR-2 (for 12 traits); KMR-10-1, Maya , PKRS-28 (for 11 traits and RH8814(for 10 traits).

Keywords:Genetic Gain, Rainfed, Heritability, Genetic Advance, Moisture Stress

HEAVY METALS REMOVAL FROM WASTEWATER BY USE OF LOW COST ADSORBENT

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Industrialization moves so rapid that disposed of heavy metals into environment increase accordingly heavy metals must have been density relative to water of greater than 5ppm. Cd, Cr, Pb, Cu, Hg, Ni are commonly found in this water not biodegradable on bioaccumulation in living organism. Cd are natural component of the earth crust and inevitable by-product of Zn or occasionally Pb, refining clinical effect of cadmium is osteomalasia, osteoporosis, renal failure, cardiovascular, cancer of Lungs, Kidney and prostate, Itailtai. World Health Organisation (WHO) recommended maximum permissible unit for Cd, Cu concentration in drinking water should be 1mg/l. The Application of low cost adsorbent obtained from Eco waste a replacement from costly conventional method of removing heavy metals ion from wastewater has been revived adsorption capacity of the adsorbent (Plant leaves) was determined as the function of pH of solution, contact time and initial concentration of the solution. A comparative study has also been done on the adsorption capacity of Eco waste powder (Azadirachta indica & Dalbergia sisso). In present study low cost Eco waste powder adsorbent prepared using chemical activation process and the surface measured. According to the Environmental Protection Agency (EPA), removal of heavy metals from dissolve water should be dominant concern for society due to adverse effect on both public and environmental health, because of heavy metals removal from any polluted water body should not be come into contact with environment, must be prior issue and there is type of conventional technique which is able to remove heavy metals (increase in removal efficiency with the increase in contact time and pH to certain value) from waste water, used by precipitation, ion exchange ,reverse osmosis , membrane separation and adsorption , adsorption is one of the most repeatedly and auspicious method of heavy metals removal due to their own easy operation and high efficiency , cost effective , economically benefit for human and industries also.

Keywords: Heavy metals, adsorption, environmental health, Eco waste powder.

RICE BIOFORTIFICATION: TACKLING MICRONUTRIENT DEFICIENCY

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Micronutrient deficiency is one of the major problems faced by humanity. It's more prevalent in poor countries that lack required infrastructure for nutrient supplementation and fortification. Iron deficiency anemia, which is one of the most common forms of micronutrient deficiencies, affects 2 billion people worldwide. Women and children are worst affected. Biofortification is a strategy where crops under cultivation are fortified with nutrients through biological means. Both conventional breeding as well as genetic engineering methods can be employed to biofortify crops with essential minerals and nutrients. Biofortification through transgenic approach is a reliable strategy to mitigate micronutrient deficiency. Rice is a target crop of such biofortification programs mainly because it is a staple crop of the third world nations and also because it is deficient in micronutrient especially dietary iron. Most of the nutrients are deposited in its aleurone layer which is lost during milling. Furthermore, the mechanism of iron accumulation and uptake is well versed in rice. There lies a crosstalk between iron and zinc transport pathways since transgenic plants with overexpressed Fe transporters also showed increased Zn accumulation. Several literatures have cited examples of biofortifying rice with iron and zinc using various iron homeostasis genes. We have also demonstrated enhanced levels of iron and zinc by using *ferritin* genes of *Avicennia marina* driven by rice glutelin promoter and *Nicotianamine synthase-1 (Nas-1)* from barley driven by maize ubiquitin promoter. Such biofortification programs can complement other strategies like supplementation and fortification to remove micronutrient deficiencies particularly in remote areas where such methods are not feasible.

Keywords: Biofortification, Genetic transformation, Iron deficiency anemia, Micronutrient deficiency, Rice

AGROFORESTRY AS AN OPTION FOR SUSTAINABLE RURAL LIVELIHOOD SECURITY TO FARMING COMMUNITY OF INDIA.

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The growing food insecurity and deteriorating livelihood situations call for concerted and consorted actions at national and international levels to take advantage of the high potential of agroforestry, among other systems, for promoting best land use practices. Agroforestry, as a science and practice, has the potential to contribute to the improvement of rural livelihood, due to the capacity of its various forms to offer multiple alternatives and opportunities to smallholders to enhance farm production and income, while protecting the agricultural environment. In most of the areas especially in rainfed agricultural system in India, the management of trees in conjunction with crops and/or animals, minimizes the risks of stress period through crop diversification and efficient utilization of the resources therein. Thus, agroforestry can play crucial role in managing the risks

under such stress period of most concern. Even earlier studies had revealed that, the agroforestry practices are more profitable than arable farming. But then, selection of area specific and need based agroforestry models are one of the important criteria to maximize farm output and returns. Sustaining livelihood is most serious challenge faced by policy and decision-makers in current scenario. In this context land-use options that sustain livelihood security and reduce vulnerability to climate and environmental change are necessary. Agroforestry can play a major role in bringing the desired level of diversification along with sustainability. Agroforestry has the potential to provide food security and help to poverty reduction. Traditional farming and their management such as agroforestry practices may potentially provide options to enhance livelihoods through simultaneous production of food, fodder and firewood as well as reduce of the impact of climate change. Moreover, emphasis should be given on tangible benefits (*viz.*, revenue generation) from agroforestry systems.

Keywords: Agroforestry, Livelihood, Poverty, Revenue, Sustainability.

EFFECTS OF CLIMATE CHANGE ON PRODUCTION OF RICE CROP

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India is second of the largest food consumers in the world after China. It is currently experiencing obvious impacts of climate change. Global demand for rice continues to grow while production resources are diminishing. Increasing climatic changeability poses further challenges. Therefore, ensuring agricultural sustainability necessitates a transformation of the production system to make it more productive, less input required and to lower the environmental footprint. The major impacts of climate change (drought, aberrant rainfall, increasing temperature and salinity stress etc.) were the reduction of rice yield potential (due to less spikelet fertility and reduced grain filling duration) and issues of various diseases during lack of available soil moisture. Decreases in rainfall (available soil moisture) had a substantial negative impact on the production potential of rice crop. Adjusting the structure of agricultural cultivation farms and appropriately expanding the planting area of rice to adapt to climate change. Accelerating the construction of agricultural infrastructure to reduce the negative impact of declining rainfall and increasing day-time temperature on rice production is also a high priority in order to safeguard food security. The rice crop yield is highly sensitive to climate change and tremendous climate if CO₂ is high then rice production increased. The rice yield would be lowered by almost 2.5 % with a 1 °C increase in the mean growing season temperature. Increasing the temperature has a significant adverse effect on rice production whereas minimum temperature has a substantial positive effect on optimum yield. Conversely, the rice yield would increase by approximately 3.0 % with a 1 M J m⁻² increase in the mean growing season downward shortwave solar radiation. Extreme climate indices were strongly correlated with the rice yield. This is the highlights that how climate change including temperature, solar radiation, water use and extreme climate (drought, aberrant rainfall) will affect the rice yield. Concede of Climate Smart Agriculture can enhance adaptation and mitigation of climate change and overall food security in India.

Keywords: Climate Change, drought, rainfall, temperature, food security, Rice yield potential.

EFFECT OF FOMESAFEN + FLUAZIFOP-P-BUTYL ON GROWTH AND PRODUCTIVITY OF RABI GROUND NUT IN LATERITIC SOIL OF WEST BENGAL

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Groundnut (*Arachis hypogaea* L.) is also known as poor man's cashew nut and wonder nut. It is also known as unpredictable leguminous crop. The yield of groundnut is lost in various ways, among all, weed infestation is considered as one of the major due to the initial slow growth habit of the crop. Weed interference resulted in maximum yield losses between 74 and 92 per cent. Thus, use of herbicides is one of the options left with the farmers to eliminate crop weed competition at early growth stage of crop. A field experiment was conducted during rabi season 2017-18 at the Agricultural Farm, Sriniketan with Groundnut variety 'TG 24' to study the effect of Fomesafen + Fluazifop-p-butyl on weed management as well growth and productivity of Groundnut. The experiment comprising of ten treatments viz. T₁-Fomesafen + fluazifop-p-butyl @ 100+100g ha⁻¹, T₂-Fomesafen + fluazifop-p-butyl @ 125+125 g ha⁻¹, T₃-Fomesafen + fluazifop-p-butyl @ 150+150 g ha⁻¹, T₄-Fomesafen + fluazifop-p-butyl @ 175+175 g ha⁻¹, T₅-Fomesafen + fluazifop-p-butyl @ 250+250 g ha⁻¹, T₆-Imazethapyr @ 100.0 g ha⁻¹, T₇- Fluazifop-p-butyl + fomesafen @ 125+125 g ha⁻¹ (Fusiflex), T₈-Hand weeding at 15 and 30 Days after Sowing (DAS), T₉-Weedy check and T₁₀-Weed free check and replicated thrice. Result revealed that doses of fomesafen + fluazifop-p-butyl at (125+125, 150+150, 175+175 and 250+250 g ha⁻¹) significantly reduced the weed infestation and registered lower weed density, weed dry weight, higher weed control efficiency and yield attributes and yield of groundnut over T₆-Imazethapyr @ 100.0 g ha⁻¹, T₇- Fluazifop-p-butyl + fomesafen @ 125+125 g ha⁻¹ (Fusiflex) and at par with two hand weeding. Weed management had positive and favourable influence in improving plant height, yield attributes like number of pods plant⁻¹, number of kernel pod⁻¹ and 100 kernel weight of groundnut under study. There was no phytotoxicity observed in any of the doses of the testing herbicide in groundnut and its effect on succeeding transplanted rice crop.

Keywords: Fomesafen + Fluazifop-p-butyl, groundnut, phytotoxicity, WCE

International Web Conference: Perspectives on Agricultural and Applied Sciences in COVID-19 Scenario (PAAS-2020) (October 4-6, 2020)

PHYTOREMEDIATION OF SOIL CONTAMINATED WITH CHROMATED- COPPER- ARSENATE USING SPECIES OF *EUCALYPTUS*

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Phytoremediation, a novel green plant-based technology, gained much popularity recently for the remediation of contaminated soil, sediments, and water. It is apparent that, a few higher plant species can survive and reproduce in highly-metal contaminated soils by evolving heavy metal tolerance strategies. In this study, the performance of two fast growing tree species namely, *Eucalyptus citriodora* and *Eucalyptus tereticornis*, were evaluated in terms of tolerance and accumulation of Chromium, Copper and Arsenic in the soil contaminated with Chromated-Copper-

Arsenate (CCA) under potting conditions. The results showed that, the growth of root and shoot and the size of biomass of two tree species were high in lower concentrations, but were reduced with increase in the concentration of CCA in the soil. Interestingly, the roots accumulated three to four times higher levels of Chromium, Copper and Arsenic than that of shoots. Comparatively, *E. tereticornis* species accumulated greater quantity of Copper, Chromium and Arsenic than *E. citriodora*. Thus, it is concluded that, Eucalyptus species are potential higher plants for phytoremediation of CCA contaminated soil through heavy metal tolerance and accumulation of chromium, copper and arsenate in their roots and shoot.

Key Words: Eucalyptus species, Chromated- Copper- Arsenate, tolerance, accumulation

STUDIES ON BIOCHEMICAL CHANGES IN EUCALYPTUS SPECIES GROWN IN SOIL CONTAMNATED WITH CHROMATED- COPPER -ARSENATE

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Chromated- Copper- Arsenate (CCA) is a widely used wood preservative containing chromium, copper and arsenate compounds. Exposure of plants to various concentrations of CCA leads to physiological and biochemical changes. In this context, studies on biochemical changes in the saplings of *Eucalyptus citriodora* and *Eucalyptus tereticornis* grown in soil contaminated with CCA, were conducted in potting conditions. The results revealed that, the biochemical parameters *viz*, the levels of total sugars, protein and chlorophyll content were decreased with increase in the concentrations of CCA in Eucalyptus tree species. Similarly, maximum levels of biochemical parameters were recorded in a treatment with 250 ppm CCA concentration and minimum levels in 2500 ppm in both the tree species. Comparatively, *E. tereticornis* recorded higher amounts of total sugars, protein and chlorophyll content than that of *E. citriodora*. Further, the maximum and minimum quantity of total sugars recorded in *E. citriodora* and *E. tereticornis* were 2.72 mg/g and 0.97 mg/g and 2.73 mg/g and 1.70 mg/g respectively. However, the weight of total protein content was varied from 1.15 mg/g to 0.42 mg/g and 1.54 mg/g and 0.45 mg/g and the total chlorophyll content from 0.20 mg/g to 0.11 and 0.24 mg/g to 0.06 mg/g, respectively. On the basis of the results, it is concluded that, *E. teretocornis* is a better tolerant tree species to CCA with increased levels of biochemical parameters than *E. citriodora*.

Keywords: Biochemical changes, Chromated - Copper- Arsenate, Eucalyptus species,

ECONOMIC ANALYSIS OF MARKETING CHANNEL OF PADDY CROP IN AURAIYA DISTRICT OF UTTAR PRADESH

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Agricultural marketing has its greatest and important enduring role to play in increasing food production. The study examines the profitability of paddy marketing to evaluate the performance of different marketing channels. The study was conducted in Bidhuna and Sahar block in Auraiya district of Uttar Pradesh. 100 respondents were selected following the proportionate random sampling technique from 10 villages from 02 blocks to collect the required information on the cost of cultivation, marketing and other aspects for the present study. Three different marketing channels were identified in the study area, viz., (i) producer - consumer, (ii) producer – village trader – consumer and (iii) producer – village trader – whole seller – retailer – consumer. Price spread of paddy cultivation in the producer's share in consumer rupee was worked out to in case of paddy 95.65, 92.10 and 72.12 percent in Channel – I, Channel – II, Channel – III and marketing cost accounted Rs. 62.33, Rs. 114.66 and 509.33 per q. in Channel – I Channel – II and Channel – III. The study suggested the reducing harvest losses at farm level, developing adequate market infrastructure, providing improve and high yielding varieties, technology, delivery of payment at procurement centre and would be helpful to farmers realize higher net income.

Keyword: Paddy cultivation, paddy marketing, Price spread, Marketing efficiency and marketing comparison

CONSTRAINTS CAUSING TECHNOLOGICAL GAP IN POTATO PRODUCTION TECHNOLOGY IN KANNAUJ DISTRICT OF U.P.

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Keeping in the view of Constraints causing technological gap in Potato Production Technology, total 125 farmers from five villages of the Chhibramau block in the Kannauj district of Uttar Pradesh. Using a pre-structured interview schedule, a study was carried out with a sample of 25 respondents from each village. The results of the study depicted that according to degree of seriousness of constraints, the constraint under socio-psychological was found most important constraints, i.e. 'Skilled farm workers are hardly available'. Under economic constraints the most important constraints i.e. 'Costly diesel charges, and 'Corruption of credit sanctions,. Under technological constraints, the most important constraints was 'Non-availability of quality HYV seeds, Under transportation constraints, the most important constraints, was 'Indigenous transport-means viz., Bullock cart, Dunlop, Tonga take much time and causes more inconveniences in transporting the products, Under post-harvest technological constraints, the most improvement constraints was 'Lack of space in house of potato farmers for storing the products. The suggestive measures to overcome the constraints in potato production technology as perceived by the respondents were "suitable approach for the safeguard of the crop against the animal (blue calf) (73.33%). Most of the remedial suggestion being made in the view of the expressed opinion of the respondents, observation of the investigator, appropriate farm field fencing.

Keywords: Potato growers, Technological gap, Constraints, suggestions

EVALUATION OF KHARIF ONION (*Allium cepa* L.) VARIETIES IN MALWA AGRO CLIMATIC ZONE OF MADHYA PRADESH

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The on farm testing was conducted in the farmers' fields of Dewas district of Madhya Pradesh with the objective to find out the most suitable varieties of kharif onion for two consecutive years i.e. 2018-19 and 2019-20. From the study it is revealed that onion variety Bhima Dark Red performed better in growth, yield, yield attributing parameters and economic returns as compared to Agrifound Dark Red and N-53 varieties. Maximum plant height (58.37 cm), number of leaves per plant (12.29), leaf length (52.18 cm), bulb diameter (6.04 cm), fresh weight of bulb (103.10 g), cured weight of bulb (90.84 g), bulb yield (219.55 q/ha) and minimum neck thickness of bulb (1.10 cm) and bolting percentage (0.55%) were found in Bhima Dark Red. Bhima Dark Red variety recorded additional net returns of Rs. 53,320 and Rs. 2,44,819 over Agrifound Dark Red and N-53. Highest B:C ratio was obtained with Bhima Dark Red (6.57) as compared to Agrifound Dark Red (5.99) and N-53 (3.03).

Keywords: On farm testing, Kharif Onion, Bhima Dark Red, Agrifound Dark Red, Yield

MORPHOLOGICAL VARIABILITY STUDY IN DIFFERENT ISOLATES OF GROUNDNUT *Sclerotium rolfsii*

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Groundnut (*Arachis hypogaea*L.) is oilseed crop largely grown throughout the world. Among the diseases of groundnut, *Sclerotium rolfsii* caused stem rot is soil borne pathogen and has wide host range. In present investigation, morphological variability was confirmed after isolation and identification of different isolates of *S. rolfsii*. Distribution pattern of all isolates of *S. rolfsii* divided into six groups after shown considerable variations on potato dextrose medium. Highest number of sclerotia was produced by SrBKL isolate followed by in SrBKN, SrS and SrJPF isolates whereas lowest sclerotia were produced by SrJPP, SrT and SrH isolates. The sclerotia produced by all isolates were in ranged of 115 to 375 per Petri plate. Based on the colour of sclerotia, all isolates were categorized in four groups. All isolates of *S. rolfsii* produced light dark brown, dark brown, light dark and brown colour of sclerotia. The diameter of sclerotia produced by various isolates varied from 0.32 mm to 0.68 mm and categorized in two groups. The highest diameter of sclerotia (0.68 mm) was recorded in SrJPP isolate whereas lowest diameter of sclerotia (0.32 mm) was observed in SrG isolate. All the isolates of *S. rolfsii* showed considerable variation in the weight of sclerotia and the 100 sclerotia weight ranged from 85.54 mg (SrG) to 145.13 mg (SrJPP) isolate. Morphological variability study have vital role in identification of *S. rolfsii*.

ORGANIC FARMING- AN ECOFRIENDLY APPROACH TOWARDS THE SUSTAINABLE AGRICULTURAL DEVELOPMENT

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Agriculture plays a vital role in a developing country like India. Apart from fulfilling the food requirement of the growing Indian population, it also plays a role in improving economy of the country. The development of the organic farming worldwide had gone through three stages, emergence, expansion, and growth. Organic farming through sustainable agriculture meets not only the food requirements of present generation in an environment friendly way but also the requirements of future generations and maintains our environment. Modern agriculture involving high-yielding varieties are being used with infusion of irrigation water, fertilizers, or pesticides. It causes negative impact on environment by affecting soil fertility, water hardness, development of insect resistance, genetic variation in plants, increase in toxic residue through food chain and animal feed thus increasing health problems and many more serious health concerns and degradation of environment. Organic farming provides macronutrients and micronutrients to the plants and also improves soil physical, chemical and biological characteristics of soil. Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. The production of these organic crops and products is viewed with regard to sustainable agricultural development . There are existing problems for the further development of the world's organic farming, as well as the development status, problems and strategies of the organic farming.

Keywords: Organic farming, Economy, Sustainable agriculture, Ecosystem and Biodiversity etc.

SOIL AND WATER CONSERVATION: A GOAL TOWARDS THE SUSTAINABLE DEVELOPMENT OF HUMAN SOCIETY

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Conservation of soil and water assets is significant for supportability of farming and environment. Soil and water assets are feeling the squeeze because of consistently expanding population. Soil and water assets are being crumbled because of various anthropogenic and natural factors. Soil erosion may prompt the noteworthy loss of soil efficiency and in this manner may prompt the desertification under cut off conditions. Deforestation, over-grazing, bungle of developed soils, concentrated development and serious urbanization are central point setting off the soil disintegration. For reasonable farming and condition, it is appropriate for the assurance of soil assets against disintegration. Distinctive control measures ought to be embraced to ensure the soil assets against disintegration. The idea of soil protection can't be appeared without moderating and proficient utilization of water assets. It is in this way pre-imperative that soil conservation practices ought to be embraced. Poor soil and water protection estimates will prompt land degradation that are either normal or human initiated. Soil protection practice incorporate soil management, crop management,

engineering, range management and forestry operation. It is now common sense that soil and water conservation is the insurance for national ecology and its development. Henceforth, protection and manageable advancement of soil and water assets is one of the essential standards for the general improvement of human culture.

Keywords: Soil conservation, Soil erosion, Deforestation, Soil and water assets, Crop management and Soil protection etc.

PULSES FOR SUSTAINABLE SOIL MANAGEMENT

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The climatic variations and swiftly increasing the world's population are crucial drivers of universal famines and lead to the stern food insecurity. These factors affect all the magnitudes of food collateral, such as food accessibility, consumption, reliability, and constancy, and also strengthen additional calamities allied with health concerns of plants, animals, and environment. Although applications of agrochemicals to the soil largely contributed to increased food production, extensive use of these leads to the nutrient disparity and environmental hazards resulting in considerable economic losses. Consequently, it is utmost important to manage the application of agrochemicals with the aim of increased food production in environmental as well as economical unthreatened manner. Pulses have a great potential to enhance crop diversity as well as productivity and to reduce dependence on exterior inputs as legumes are well known for their illustrious capabilities such as nitrogen (N) fixation by biological means, increase in soil organic matter (SOM), efficient roles in nutrient and water retention, and improvement in soil properties which contribute to recover soil health. These manifold abilities of pulses make them potential candidates for management of agriculture in a sustainable way. The upshots of sustainable agriculture can be optimistic for higher food production and to ensure future food availability in an eco-friendly manner by reducing the usage of agrochemicals and maintaining the nutrient balances in the soil.

Key words: Pulses, Environment, Crop diversity, Nitrogen fixation and Eco-friendly.

EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON RABI FENNEL AND THEIR RESIDUAL EFFECT ON SUCCEEDING GREEN GRAM CROP

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A field trial was conducted during three consecutive *Rabi* season of 2012-13 to 2014-15 at Seed spices Research Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan (Gujarat) Effect of different weed management practices on rabi fennel and their residual effect on succeeding greengram crop. Significantly, lowest and highest weeds density at harvest was recorded with Hand weeding and IC at 20 and 40 DAS, Pendimethalin @ 1.0 kg /ha as PE + I.C. followed by H.W. at 30 DAS and Unweeded control, respectively. weed free up to 45 DAS recorded

significantly higher fennel yield and remained at par with the treatments Pendimethalin @ 1.0 kg /ha as PE + I.C. followed by H.W. at 30 DAS, Hand weeding and IC at 20 and 40 DAS, Oxadiargyl @ 100 g/ha as PE + I.C. followed by H.W. at 30 DAS and Pendimethalin @ 1.0 kg /ha as PE + Oxadiargyl @ 100 g/ha as PoE at 20 DAS and were recorded significantly higher seed yield over rested treatments. Significantly higher plant height, number of umbels/plant and seed yield was recorded with Crop kept weed free up to 45 DAS recorded significantly higher plant height, number of branches and umbels/plant, number of umballates per umbel, seeds per umballates as well as test weight and was remained at par with treatments Hand weeding followed by IC at 20 and 40 DAS, Pendimethalin @ 1.0 kg /ha as PE + I.C. followed by H.W. at 30 DAS, Oxadiargyl @ 100 g/ha as PE + I.C. followed by H.W. at 30 DAS and Pendimethalin @ 1.0 kg /ha as PE + Oxadiargyl @ 100 g/ha as PoE at 20 DAS, Pendimethalin @ 1.0 kg /ha as PE + I.C. followed by H.W. at 30 DAS recorded higher net income (Rs. 1,08,406 /-) and BCR (2.38) also Which was closely followed by treatments T5 (Pendimethalin @ 1.0 kg /ha as PE + Oxadiargyl @ 100 g/ha as PoE at 20 DAS), (I.C and H.W. at 25 and 40 DAS) and weed free up to 45 DAS recorded BCR values of 2.32, 2.27 and 2.19, The population of greengram in each plot found sufficient and there was no any significant reduction of plant population of green gram.

Keyword: Weed, green gram, management, Fennel.

GUJARAT AJWAIN 2: HIGH YIELDING AND BOLD SEEDED CULTIVAR

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A new variety of Ajwain (*Trachyspermum ammi* L.), Gujarat Ajwain 2 (GA 2) was tested in eight trials at Jagudan and two trials at Junagadh, it was found superior than Gujarat Ajwain 1 in all the trials. Under Gujarat climatic condition, Gujarat Ajwain 2 had recorded yield of 1222 kg/ha, which was 13.25 per cent higher than check Gujarat Ajwain 1. Average yield under normal conditions was 1134 kg/ha. (It is 14.55 per cent higher than Gujarat Ajwain 1). The new variety had uniform seed size with attractive seed colour, bold seed size, more pungent and good aroma. The essential oil and *thymol* content of seed were higher than Gujarat Ajwain 1. Gujarat Ajwain 2 had Medium leafy, light green foliage colour, more branches and tall height. Due to all above salient feature variety was recommended for release in Gujarat state.

Keywords: Gujarat Ajwain 2, Essential oil, thymol

APPLICATION OF HORTON'S INFILTRATION MODEL FOR THE SOIL OF DEDIAPADA (GUJARAT),

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The design and evaluation of surface irrigation systems of a site requires reliable data of infiltration which could be provided by an infiltration model. In this study, Horton's infiltration model has been estimated for the soil located in a field of College of Agricultural Engineering and Technology,

Dediapada, Gujarat using the infiltration data obtained from several locations in the field using double ring infiltrometer. The decay constant of the Horton's infiltration model was obtained using graphical method and also by using semi-log plot of t (time) vs. $(f - fc)$, where f is the infiltration rate (mm/hr) and fc is the initial rate of infiltration capacity (mm/hr). The potential of the Horton's infiltration model so obtained was evaluated by least square fitting with the observed infiltration data. The Horton's infiltration model was used to estimate infiltration rate (mm/hr) and cumulative infiltration (cm). The Horton's model for infiltration rate obtained by semi-log plot method was obtained as $i = 20 + 94 e^{-1.02t}$, where i = infiltration rate (mm/hr) and t = time (min). The coefficient of determination obtained when the infiltration model was applied to observation data taken at various points in the field were found to 0.96. Therefore, it could be inferred that the Horton's infiltration model could give a reliable estimate of infiltration for the soil of Dediapada.

Keywords: Cumulative infiltration, Double ring infiltrometer, Graphical method, Horton's Infiltration model, Infiltration rate

RESPONSE OF CUMIN (*Cuminum cyminum* L.) VARIETIES TO LEVELS OF FERTILIZER AND BIOFERTILIZERS

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A field experiment was carried out SDAU, Sardarkrushinagar during *rabi*, 2017-18 on loamy sand soil. Twelve treatment combinations comprising of two varieties (GC 3 and GC 4), two levels of fertilizer (100% and 50% RDF) and three levels of biofertilizers (*Azotobacter* + PSB, *Azospirillum*+ PSB and NPK consortium) were laid out in randomized block design (factorial) with four replications. The results of present investigation revealed that significantly higher plant height at harvest, number of branches/plant, number of umbels/plant, number of umbellates/umbel, test weight, seed and straw yields; harvest index, volatile oil content, net return and B:C ratio were found with variety GC 4 and under the treatment of 100% RDF. Plant height at harvest, number of branches/plant, number of umbels/plant, number of umbellates/umbel, test weight, seed and straw yields; volatile oil content, net return and B:C ratio were found significantly higher under *Azospirillum*+ PSB. Higher microbial status of soil was found significantly higher under variety GC 4, 50% RDF and seeds inoculated with *Azospirillum*+ PSB. Significantly higher seed and straw yields were recorded when cumin crop was fertilized with 100% RDF and inoculated with *Azospirillum*+ PSB. Highest net return and B:C ratio were realized when cumin GC 4 seeds treated with *Azospirillum*+ PSB along with 40:15:00 NPK kg/ha. On the basis of experimental results, it is inferred that for obtaining potential production and higher net profit from cumin variety GC 4, it can be fertilized with 100% RDF alongwith seed inoculation of *Azospirillum*+ PSB.

Keywords: Cumin, fertilizer, yield and PSB.

SEASONAL VARIATION IN HERBACEOUS VEGETATION ALONG THREE DIFFERENT ALTITUDES OF BENHAMA, KASHMIR

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The present investigation entitled "Seasonal Variation in herbaceous vegetation along three different altitudes of Benhama, Kashmir" was carried at Faculty of forestry, Sher-e-Kashmir

University of Agricultural Sciences and Technology of Kashmir, Benhama, Ganderbal, Jammu and Kashmir during the year 2015-2016 with the aim to evaluate the seasonal change in floristic composition and phytosociology of herbaceous species at selected site. The Vegetational analysis was done by harvesting sampling plots. Study site was divided three altitudes. At each altitude, five quadrats of size 1.25m x 1.25m were laid for herbaceous species. The floristic surveys conducted in the study area during the study period resulted in the identification of 64 plant species belonging to 18 families. The phytosociology of the different elevations revealed that *Cynodon dactylon* dominates all the three altitudes at the site. The phytosociological attributes of herbaceous species decreased along the altitudinal gradient. There is an increasing trend in the number of species mostly during spring and summer season and declining trend towards autumn season.

Keywords: Altitude, phytosociology, season, vegetation

PERFORMANCE OF SUGARCANE GENOTYPES ON CANE PRODUCTIVITY

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Sugarcane (*Saccharum* spp. hybrid complex) is the most important cash and agro industrial crop which is being cultivated in around 5.06 million hectares area in India. The major producing states are Uttar Pradesh, Maharashtra, Tamilnadu, Karnataka and Gujarat in which leading state Uttar Pradesh having the 26.78 lakh hectare area and average cane productivity 81.10 t/ha with sugar recovery 11.50 per cent. A Field experiment was conducted at research farm of Genda Singh sugarcane breeding and research institute, Seorahi, Kushinagar, Uttar Pradesh during 2018-19 and 2019-20. The experiment consisting of four sugarcane genotypes i.e. V₁- CoS 13231, V₂- CoS 13235, V₃- CoS 14231, V₄- CoSe 15451, two fertility levels i.e. F₁-100 per cent recommended dose of NPK, F₂-100 per cent recommended dose of NPK +25 per cent nitrogen through organic manure + biofertilizers (Azotobactor+PSB@10 kg/ha each) and two plant geometry i.e. S₁-90:30 cm, S₂-120:30 cm in trench were laid out in factorial randomized block design with three replications. The soil of the experimental site was medium in organic carbon, low in available phosphorus and potash with pH 8.03. An experiment was conducted in spring season to find out the fertility levels and plant geometry of promising sugarcane genotypes. The experimental findings on the basis of pooled data of two years showed that CoS 14231 produced significantly higher germination per cent (50.10) and cane yield (103.28 t ha⁻¹) against CoS 13231, CoSe 15451 and CoS 13235 genotypes. Shoot population and number of millable cane were recorded significantly higher in CoS 14231 (139.99 and 112.02 thousand ha⁻¹, respectively) over remaining tested genotypes. Genotype CoS 13231 noted significantly higher commercial cane sugar (13.52 per cent) as compared with remaining genotypes. Effect of fertility levels and plant geometry on germination and CCS per cent were not obtained significantly values. Recommended dose of NPK+25 per cent N through organic manure+biofertilizers application produced significantly higher shoot population (128.81 thousand ha⁻¹), NMC (95.21 thousand ha⁻¹) and cane yield (86.59 t ha⁻¹) over recommended dose of NPK. Effect of plant geometry on shoot population, NMC and cane yield were recorded significantly higher in 90:30 cm trench method.

Key word: Sugarcane, genotype, performance, productivity, fertility, geometry

STANDARDIZATION AND *IN VIVO* ANTI-OBESITY EVALUATION OF HERBAL TABLETS CONTAINING AMLA AND GINSENG

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Obesity, a metabolic disorder with an incidence of about 40-52% across the globe affects people of all age groups and is the root cause of major diseases of liver, kidney and heart. The present study was aimed to standardize seven marketed herbal anti-obesity products in an effort to validate the claims of quality (physicochemical parameters, quantitative analysis of markers, stability testing) and efficacy (anti-obesity activity) of the herbal products. There is no documented evidence on standardization of Ginseng and Amla combination anti-obesity herbal products. Hence, this research was selected that anticipated to provide assurance on quality, safety and efficacy of these products, thereby validate the incorporation of amla and ginseng in anti-obesity marketed products. Seven products- 3 containing amla, 3 containing ginseng and one polyherbal tablet were selected. The actives (ascorbic acid and ginsenoside rb1) were quantified by UV spectroscopy and dissolution studies were performed as per the API protocol. The products were evaluated for estimation of total phenolic content and total flavonoid content. They were screened for antioxidant activity using the hydrogen peroxide scavenging assay and nitric oxide assay in accordance with the WHO guidelines. The test samples were subjected to 3-month real-time stability testing protocol as per ICH guidelines. The *in vivo* efficacy of the products was conducted via the anti-obesity activity using high-fat diet induced obese albino wistar rats. The test products passed the dissolution test at the first stage ($Q_{60} \geq 75\%$), the total phenolic and flavonoid content were in the range of 16-175 mg GAE/g and 15-37 mg QE/g respectively. The IC_{50} of the products in the H_2O_2 and NO assays were found to be 370-450 $\mu\text{g/ml}$ and 125-195 $\mu\text{g/ml}$ respectively. All the test products were found to be stable under the test conditions. The results of *in vivo* anti-obesity studies indicated that all the products led to reduction in body weight, serum cholesterol, LDL, VLDL and triglyceride in the obese rats, with arising at a conclusion that combination product was the best of the tested samples. This standardization protocol is important to measure and ascertain the quality standards of herbal products. The results of this study illustrated that all marketed products were of good quality, stable and effective as anti-obesity products.

Keywords: Standardization, Anti-obesity, Amla, Ginseng, Ascorbic acid, Ginsenoside Rb1.

GENETIC EVALUATION AND SELECTION OF SUPERIOR MUTANTS IN INDIAN MUSTARD (*Brassica juncea* L.)

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The present study was conducted at farm of Agricultural Botany Section, College of Agriculture Nagpur during *rabi* 2017 in M_3 generation. 122 mutants along with four checks (Shatabdi, Kranti, Pusa bold and Bio 902) were evaluated in three replications. Data were recorded on days to maturity, plant height, number of primary branches, number of siliqua plant⁻¹ and seed yield plant⁻¹. In M_3 generation 65 individual plants from 47 progeny were selected and these mutants will be further evaluated in M_4 generation of those found superior will be forwarded to yield trials.

Keywords: Mutant, genetic evaluation, selection

STUDIES ON WEAR CHARACTERISTICS OF AGRICULTURAL DISC

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G. B. P. U. A. & T. Pantnagar

The discs used in disc harrow are largely manufactured by the small scale industries. Due to improper material, the quality of disc does not conform to the Bureau of Indian Standards resulting in high wear rates and reduced life. A project was undertaken to find out the wear characteristics of disc at different soil and operational parameters. The soil bin is made from RCC in circular shape having an outside and inside diameter of 3220 and 1650 mm respectively. This provides an annular space with width of 1070 mm for operation of tool carriage with discs in continuous mode. The depth of soil bin is 1500 mm for filling the sand or soil. In the wear loss in disc with different hardness was assessed against abrasive sand in circular soil bin. The soil moisture, depth of operation and speed were kept 0-2 %, 10 cm and 2.5 km/h respectively. A uniform soil condition was maintained during the experiment. Based on experimental data an empirical equation was developed to estimate the gravimetric wear loss (g). The disc with 45 HRC was found best. The disc wore out along the thickness and the maximum decrease in thickness was found at the edge of the disc.

Keywords: disc harrow, hardness, sand, circular soil bin

EFFECT OF BIO-STIMULANTS ON PHYSIOLOGICAL PERFORMANCE IN COWPEA

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The present investigation was carried out during the summer season of 2019 in cowpea genotype (CS-88). The physiological parameters in cowpea plant like water relation, gaseous exchange studies, chlorophyll stability index, chlorophyll content (SPAD units) and photochemical quantum yield showed declining trend in rainfed condition. But with the imposition of different biostimulants at flower initiation stage, values of physiological parameters found to be increased. Values ranged from control to biostimulant application in osmotic potential (-MPa) (-1.24 to -1.09), RWC (%) (72.7 - 88.7), assimilation rate ($23.31 - 29.73 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$), transpiration rate ($1.70 - 2.07 \text{ mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$) and stomatal conductance ($0.02 - 0.03 \text{ mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$). Similarly, chlorophyll content (SPAD units) and photochemical quantum yield also showed the increasing trend after foliar application of different biostimulants and the values varied from (41.0 - 51.4) and (0.678 - 0.718), respectively. Reversibly, relative stress injury was found to be decreased from control (35.51) to biostimulants application (20.58) in cowpea under moisture stress. Osmolytes enhanced under moisture stress and further increased rapidly after imposition of different biostimulants at flower initiation stage. The value of biochemical parameters ranges from proline ($131.4 - 381.9 \mu\text{g g}^{-1} \text{ DW}$) and glycine betaine ($144.0 - 424.2 \mu\text{mol g}^{-1} \text{ DW}$) over their respective control. Conclusively, based on the above studies it could be concluded that after foliar spray of different biostimulants under rainfed condition, cowpea performed better by maintaining higher plant water status, photosynthetic rate and lower values of RSI (%).

Keywords: Biostimulants, moisture stress, Cowpea

IMPACT OF LOCK-DOWN ON AGRICULTURE AND ALLIED SECTOR IN WASHIM DISTRICT.

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Study on Impact of COVID-19 lock-down on agriculture and allied sector, best emerging practices in production, processing, value addition, and marketing and initiatives of Krishi Vigyan Kendra to update farmer in these circumstances was carried out by KVK in the district. The data on Impact of COVID-19 on agriculture and allied sector reveals that 50 % rabi crops harvesting delayed due to non availability of labour and field operations were costlier. 34% farmers faced problem of sale of farm produce, Turmeric crop harvesting losses upto 75% Mostly small and marginal farmers were affected due to lockdown. Fruit and Vegetable growers has to succumb 85% losses during sale, storage and marketing due to district boundaries blocking. Marketing problem has shown the another way of direct marketing through personal contact, or use social media group. Similarly due to lock down best agriculture practices has emerged in the field of production, processing, marketing and supply chain management. 30% losses in dairy and 87% losses in poultry farming enterprise has been indicated in the study.

Keywords: Impact, Best Emerging practices, initiatives of KVK, Skill development.

KNOWLEDGE LEVEL OF KVK EXPERTS ABOUT FARMERS PRODUCER COMPANY'S (FPC)

S K DESHMUKH

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Small and Marginal farmer do not have economic strength to adopt advanced production technologies, services and marketing including processing and value addition. Through formation of FPCs farmers will have better collective strength for better access to quality input, technology, credit and better marketing access through economies of scale for better realization of income. Therefore during lockdown period online study was under taken to measure knowledge level of KVK Subject Matter Specialist (Extension Education), KVK SMS of other disciplines, stake holders from NABARD and ATMA (MACP). Knowledge test was administered to the 65 respondent in the Google form, which has reduced influence of interviewers and ease of filling the interview schedule.

IMPACT ANALYSIS OF SYSTEM OF RICE INTENSIFICATION IN FARMERS FIELD

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The front line demonstration on system of Rice Intensification, were conducted on farmers field of Damoh District during Kharif of 2015-16 and 2016-17 at two different location under irrigated condition. Prevailing farmer's practices were treated as control for comparison with improved practice i.e transplanting of rice in single seedling at two leaf stage (8-12 days) at a distance of 25cm or more in a square. The result of front line demonstration shows a greater impact on farming community due to significant increase in crop yield greater that farmers practices. The economics and benefit cost ratio of both farmers practices (FP) and Improved practices (IP) were worked out. The No. of effective tillers and grain per pencile were found lower (15/plant and 68/penicle) in FP and found higher (35/plant and 112/penicle) in IP. An average of Rs. 61000/ha was recorded net profit under IP, where It was Rs. 22200/ha under FP. Benefit cost ratio was 2.65 under IP, where it was 1.88 under FP. By introducing the improved technology i.e. SRI. Yield potential and net income from rice cultivation can be enhanced to a great extent with increase in the income level of the farming community of the District.

CONSERVATION AGRICULTURE -A POWERFUL OPTION FOR MEETING FUTURE FOOD DEMANDS

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The worldwide consensus-plough-based farming, as still widely practised, has unsustainable elements, whose continued promotion and application endangers global capacities to respond to the food security concerns. Ploughing and removal of crop residues after harvest leave soil naked and vulnerable to wind and rain, resulting in gradual, often unnoticed erosion of soil. Erosion also puts carbon into the air where it contributes to climate change. Crop production systems based on intensive and continuous soil tillage have led to excessively high soil degradation rates in grain producing areas. This adds to the growing problems with profitability and poverty in some of the rural areas. Conservation agriculture is seen as an ideal system for sustainable and climate-smart agricultural intensification, through which farmers can attain higher levels of productivity and profitability (i.e. or 'green prosperity') while improving soil health and the environment. Conservation agriculture (CA) is characterized by minimal soil disturbance, diversified crop rotations, and surface crop residue retention to reduce soil and environmental degradation while sustaining crop production. CA involves changing many conventional farming practices as well as the mindset of farmers to overcome the conventional use of tillage operations. Although adoption of CA is increasing globally, in some regions it is either slow or nonexistent. The adoption of CA has both agricultural and environmental benefits but there is a lack of information on the effects and interactions of key CA components which affect yield and hinder its adoption. In this chapter, we discuss the basic concepts CA, and its impacts on agricultural systems.

Key words:Conservation agriculture, ploughing, erosion, soil health, environment

CROP MANAGEMENT PRACTICES IN CHICKPEA UNDER SOUTHERN DRY ZONE OF KARNATAKA

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Among different pulses chickpea (*Cicer arietinum*) is an important pulse crop next to horsegram, greengram and blackgram under rainfed condition of Chamarajanagar district. Growing of JG-11 and other local varieties susceptible to wilt with higher seed rate (40-44%), broadcasting, no seed treatment, only FYM applied and imbalanced use of fertilizers and use of indiscriminate use of insecticides has resulted in reduced productivity and increased cost of cultivation. The productivity of chickpea in district is (328 kg/ha) is very less as compared to state (718 kg/ha) and national average (859 kg/ha). To increase the production and productivity of chickpea, KVK Chamarajanagar has conducted demonstrations on integrated crop management (New variety Jaki-9218- medium duration; Line sowing; recommended seed rate; Seed treatment with Trichoderma, Rhizobium and PSB: application of micronutrient ZnSO₄ and borax, Foliar application of DAP @ 2 % during flowering stage) in chickpea in 40 ha of area during 2019-20 in Kotamballi village . The study revealed that the demonstrated technology recorded average higher yield of 14.7 q/ha which was 37.56 % higher than farmers' practice (10.70 q/ha). This was due to good yield parameters viz., no. of pods/plant (64.1) and 100 seed weight (24.25 g) in demonstration plot than farmers practise (53.1 and 23.69 g, respectively). The extension gap, technology gap and technology index were found 4.00 q/ha, 3.30 q/ha and 18.33 % respectively. Higher gross (Rs. 63195/ha) and net returns (Rs.31250/ha) and Benefit: Cost ratio (2.13) was obtained with improved technologies in comparison to farmers' practices (Rs.46064/ha, Rs.18938/ha and 1.70, respectively). Seed treatment of seeds with Trichoderma (500g/ha) and Integrated pest and disease management has reduced the incidence of wilt (4.20 %), no. of larvae per m row (2.0) and no. of damaged pods per plant (4.30) as compared to local check (15.8%, 7.0 and 10.4, respectively).

EFFECT OF NITROGEN IN INTEGRATION WITH DIFFERENT ORGANIC SOURCES (FYM, VERMICOMPOST) IN TUBER QUALITY, TUBER YIELD OF POTATO (*Solanum tuberosum* L.) AND AVAILABLE N, P, K CONTENT OF SOIL AFTER CROP HARVEST.

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An experiment was conducted during Rabi season 2011-12 at the Research Farm of CAU, Imphal, to study the effect of nitrogen in integration with different organic sources in tuber quality, yield and available N, P, K content of soil after crop harvest. The treatment comprised of sole application of urea (RD 174 kg/ha), FYM (RD 16 t/ha), vermicompost (RD 2 t/ha) and integration of 75% RD Urea + 25% RD FYM, 75% RD Urea + 25% RD vermicompost, 50% RD Urea + 50% RD FYM, 50% RD Urea + 50% RD vermicompost, 25% RD Urea + 25% RD FYM, 25% RD Urea + 25% RD vermicompost and a control treatment. Analysis of the result showed that higher specific gravity (1.67) was observed in the treatment where 75% RD Urea + 25% RD FYM was applied and it was at par with the treatment where 75% RD Urea + 25% RD vermicompost was applied. This might be

due to balance application of nutrients from both organic and inorganic sources which help in accumulation of photosynthates in tubers. Specific gravity is an index of starch content of tuber. Higher specific gravity means higher starch content. Highest tuber yield (171.01 q/ha) was obtained in the treatment where 75% RD Urea + 25% RD FYM was applied and it was significantly better than the other treatments. Significant superior yield to sole application of full dose of FYM and vermicompost as application of organic fertilizer alone may not fully satisfy nutritional requirements to maximize crop yield. Maximum available N (476.75 kg/ha) and available K content (364.64 kg/ha) was observed in the soil where full dose of FYM (16 t/ha) was applied. Treatments with higher proportions of organic sources showed more increased available K. And highest residual P (34.75 kg/ha) was observed in the treatment where 50% RD Urea + 50% RD FYM was applied.

Keywords: Urea, FarmYard Manure, Vermicompost, Recommended dose (RD)

EFFECT OF RICE ESTABLISHMENT METHODS AND NUTRIENT MANAGEMENT PRACTICES ON SUBSEQUENT WHEAT CROP GROWN UNDER DIFFERENT ESTABLISHMENT METHODS AND NUTRIENT MANAGEMENT PRACTICES AT RAMPUR, CHIWAN, NEPAL

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A field experiment was conducted to evaluate the effect of land management practices and residual effect of nutrient management practices of rice on the performance of subsequent wheat crop in the rice-wheat cropping system in Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal during June 2018-March 2019. The experiment was executed in a split-plot, included two establishment methods viz. (i) conventional tilled dry direct-seeded rice followed by (fb) zero tillage wheat (CT-DDSR fb ZT) (ii) puddled transplanted rice followed by conventional tillage wheat (Pu-TPR fb CT) as main plot treatments, and four nutrient management practices: (i) 100% recommended dose (100% RDF; 150:45:45 and 80:60:40 kg N, P₂O₅, and K₂O ha⁻¹ respectively for rice and wheat), (ii) Residue retention @ 5 t ha⁻¹ of wheat on rice fb residue of rice on wheat + 75% RDF of each crop (RR +75% RDF), (iii) Nutrient expert (NE) dose (140:56:53; 140:60:45 kg N, P₂O₅, and K₂O ha⁻¹ for rice and wheat respectively), (iv) Brown/green manuring of *Sesbania* in ricefb rice residue @ 3.5 t ha⁻¹ in wheat +75% RDF of each crop (BM/GM fb R+75% RDF) as subplot treatments with three replications. The variety of wheat 'Bijay' was sown @120 kg ha⁻¹ with spacing 20 cm × continuous. The data on phenology, yield, yield attributes, and economics were recorded and analyzed by R studio. The study revealed that the days to heading were not affected by both factors of the experiments. None of the yield attributes and yield of wheat were significantly influenced by the rice establishment methods. Significantly more effective tillers (281.94 m⁻²) and grains per spike (44.48) and higher straw yield (5.95 t ha⁻¹) were recorded under NE dose. The grain yield of wheat was 21% and 16% more under NE dose and BM/GM fb R+75% RDF respectively compared to 100% RDF. CT-DDSR fb ZT wheat had slightly less net returns (NRs. 4523 ha⁻¹) than Pu-TPR fb CT-wheat. NE dose was the most profitable. Hence, rice establishment methods were indifferent but NE dose was the best nutrient management practice for better production and profitability for the wheat in the rice-wheat system.

Keywords: Nutrient Expert, residue, zero tillage wheat

IMPACT OF OPTIMUM TIME OF SOWING ON RAPESEED PRODUCTION – A REVIEW

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Rapeseed (*Brassica napus* subsp *napus*) is a plant of the family Brassicaceae. It is an annual oilseed crop grown in Rabi season. In World scenario, there was 19% decline in Rapeseed area in 2019-20. Rapeseed oil is a major vegetable oil in India. There is a much difference between the demand and supply of vegetable oils, so the country has to import from other countries. The reason behind such decline may be due to various reasons such as unfavorable climatic conditions, low soil nutrient status, delay time of sowing etc. Deciding a suitable planting time is very important for determining the plant growth stages to desirable environmental conditions and resulting in maximum yield. Delayed planting date negatively affected yield components. Late sowing time had negative impact on the number of branches, number of siliqua and seed yield. Optimum time of sowing is also an inevitable practice as it is an important non-monetary input to synchronize the optimum environmental condition with different phases of crop growth which is very essential for improved growth and yield. It is worthy of a great consideration as optimum time of sowing will provide better establishment and subsequently lead to yield increment. Key word : Planting time, non-monetary, synchronize, yield.

SCREENING AND ASSESSMENT OF SELECTED CHILLI (*CAPSICUM ANNUM* L.) GENOTYPES FOR DROUGHT TOLERANT AT SEEDLING STAGE

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This study was undertaken to investigate water stress tolerant mechanisms in chilli (*Capsicum annum* L.) genotypes through evaluating morphological, physiological, biochemical and stomatal parameters. Twenty genotypes were evaluated for their genetic potential to drought stress tolerant at seedling stage. Thirty days old seedlings were exposed to drought stress induced by stop watering for the following 10 days and re-watering for the following one week. Based on their survival performance two tolerant genotypes viz. BD-10906 and BD-109012 and two susceptible genotypes viz. BD-10902 and RT-20 were selected for studying stress tolerance mechanism. Drought reduced root-shoot length, dry weight, ratio, petiole weight and leaf area in both tolerant and susceptible genotypes and higher reduction was observed in susceptible genotypes. Moreover, tolerant genotypes also showed that higher recovery than susceptible genotypes after removal of stress. Importantly, comparatively longer and dense root system was observed in previously selected drought tolerant genotypes which can improve water uptake and maintain turgor and osmotic adjustment. Lower reduction of leaf area and photosynthetic pigments maintain photosynthetic activity in tolerant genotypes. Higher reduction of relative water content (RWC) may cause imbalance between absorbed and transpired water in susceptible genotypes. Higher accumulation

of stress metabolites helps in reduction of osmotic damage in tolerant genotypes. Finally, quick stomatal closing helps to avoiding dehydration effects in tolerant genotypes. Thus, the changes of morphological, physiological, biochemical and stomatal parameters help to understand the tolerance mechanism in chilli under drought stress.

Key words: Chilli, Drought, Assessment, Morphology, Physiology and Biochemical

EFFECT OF OILCAKES ON MULTIPLICATION OF ROOT KNOT NEMATODE, *Meloidogyne incognita* INFECTING BRINJAL

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A pot culture experiment was conducted in the net house of Department of Nematology, to study the effect of oilcakes on multiplication of root-knot nematode (*Meloidogyne incognita*) infecting brinjal. The experiment comprised of eight treatments in order of T₁ = Polang oilcake @ 0.5 g/kg soil, T₂ = Polang oilcake @ 1.0 g/kg soil, T₃ = Polang oilcake @ 1.5 g/kg soil, T₄ = Mahua oilcake @ 0.5 g/kg soil, T₅ = Mahua oilcake @ 1.0 g/kg soil, T₆ = Mahua oilcake @ 1.5 g/kg soil, T₇ = Neem oilcake @ 1.0 g/kg soil (Standard check) and T₈ = Untreated control. Except the untreated check, all other treatments was effective in reducing root galls and root knot nematode population in soil and root over untreated check. Among these various treatments, T₇ where neem cake @ 1.0 g/kg soil (Standard check) and T₆ where Mahua cake @ 1.5 g/kg soil were applied in pot soil, exhibited that population growth of root knot nematode and root galls were statistically at par. Both the aforementioned T₇ and T₆ treatments performing better than others contributed notable percentage of decrease in order of number of root galls by 87.07% and 75.40%, root knot nematode population by 70.25% and 68.81%, over untreated check (T₈). Though T₆ and T₇ exhibited better result as compared to other treatments and over untreated check (T₈), but for low cost management option, the best result were obtained in T₇ where application of neem oilcake @ 1.0 g/kg soil (Standard check) against root knot nematode (*Meloidogyne incognita*) infecting brinjal.

Keywords: Brinjal, Oilcakes, Root knot nematode.

BIOCHEMICAL AND NUTRITIONAL CHARACTERIZATION OF DRAGON FRUIT (*Hylocereus* SPECIES)

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Dragon fruit (*Hylocereus* spp.), is an herbaceous perennial climbing cactus, has recently drawn much attention among the people due to its economic value as a fruit and also valued for its high antioxidant potential, vitamins and minerals. *Hylocereus undatus* is characterized with white fleshed fruits with pink skin, and *H. polyrhizus* have red fleshed fruit with pink skin. The data on complete nutritional and biochemical constituents of white and red fleshed dragon fruit is limited, thus, the study was carried out to generate the nutrient composition data for both white and red fleshed dragon fruit. Yield and physical characters of fruits such as pH, TSS, titratable acidity were

measured after harvest. Proximates, phenolics, flavonoids, antioxidant potential, and mineral constituents were studied using standard procedures. Profiling of individual sugars, organic acids, phenolic acids, fat and water soluble vitamins were done using UPLC-MS/MS system.

Dragon fruit weight varies between 250-550 g, white pulped fruits measures significantly higher fruit weight than the red pulped fruit. Fruit pulp to skin ratio is about 2.7 to 3.5. Fruit has slightly acidic pH of 4.8 to 5.4. Titratable acidity varied between 0.10 and 0.23 % citric acid. Malonic acid and citric acid are predominant organic acids identified. TSS, moisture, ash, protein and dietary fibre content varied between 8-12 %, 82-85%, 0.7-0.85%, 0.90-1.1 % and 0.8-1.0 %, respectively. Total and reducing sugar content ranged between 5.13-7.06 g and 3.39-4.98 g, respectively. Glucose and fructose are the major sugars present in the fruit. Total phenolics and flavonoids content varied between 25-55 mg GAE and 15-35 mg CE per 100 g, respectively. Dragon fruit with red pulp have significantly high amount of phenolics than white pulped ones. Antioxidant potential varied between 100 to 275 $\mu\text{mol TE}$ as measured by DPPH method. Fruit contained 120-200 mg K, 30-45 mg Mg, 20-45 mg Ca, 20-35 mg P, 0.70-1.5 mg Fe and 0.20-0.40 mg Zn. Vitamin C was found maximum (~ 6 mg/100 g), followed by vitamin E (~150 $\mu\text{g}/100\text{ g}$), pantothenic acid (~ 50 $\mu\text{g}/100\text{ g}$), vitamin K1 (~25 $\mu\text{g}/100\text{ g}$) and niacin (~ 15 $\mu\text{g}/100\text{ g}$). Study on nutritional composition of dragon fruit showed that dragon fruit is rich in nutritional constituents and other biochemical compounds which offer numerous health benefits. Due to its low caloric value dragon fruit is ideal option for weight loss treatment, control of diabetes and lowering cholesterol.

ORGANIC FARMING POTENTIAL IN INDIA

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Organic farming has emerged globally as a very important sector and practiced in India for thousands of years. The great Indian civilization thrived on organic farming; India was one of the most prosperous countries in the world until the British invaded and ruled it. In traditional India, the entire industry of agriculture was practiced using organic techniques, where the fertilizers and pesticides were obtained from plant and animal products. Organic farming was the backbone of the Indian economy and cows were worshiped as sacred animals from God. The cow not only provided milk but also provided bullocks and dung. During the 1950-1960, the ever-increasing population of India, along with several natural calamities, led to a severe food scarcity in the country. As a result, the government was forced to import food grains from foreign countries. To increase food security, the government had to drastically increase food production in India. The Green Revolution became the government's most important program in the 1960s. Several hectares of land were brought under cultivation. Natural and organic fertilizers were replaced by chemical fertilizers and locally made pesticides were replaced by chemical pesticides. Large chemical factories such as the Rashtriya Chemical Fertilizers were established before the Green Revolution, it was feared that millions of poor Indians would die of hunger in the mid-1970s. However, within a few years, the Green Revolution had shown its impact. The country, which greatly relied on imports for its food supply, reduced its imports every passing year. In the 1990s, India had surplus food grains and had once again become an exporter of food grains to the rest of the world. Both consumers and farmers are now gradually shifting back to organic farming in India. It is believed by many that organic farming is the much healthier and sustainable option.

Keywords: Organic farming, fertilizers, green revolution, food supply.

POST-HARVEST PHYSIOLOGY OF VEGETABLES AND FRUITS

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Fruits and vegetable production is an emerging horticulture sub-sector in India. Postharvest Physiology is the scientific study of the physiology of living plant tissues after they are denied further nutrition by picking from the parent plant. About one-third of the fruits produced worldwide are never consumed by humans due to loss at various stages and the losses are generally more in developing countries in comparison with developed countries especially when compared between production and retail sites. Fruits, in general, show two distinctive respiratory patterns during ripening and on this basis fruits are categorized into climacteric and non-climacteric groups. Post-harvest physiology has direct applications to postharvest handling in establishing the storage and transport conditions that best prolong shelf life, for example 1-Methylcyclopropene (1-MCP) is an inhibitor of ethylene perception that can delay or prevent ripening and senescence processes in plant tissues. Pre-harvest factors also effect the post-harvest life of fruits and vegetables. Controlled atmosphere storage has been shown to be effective in reducing the post-harvest losses and prolonging the life of the produce by proper management of respiration via alteration in the gaseous composition and storage temperature. Proper understanding of the biochemistry and the underlying physiological factors will go a long way in minimising the post-harvest losses and thereby improving the socio-economic condition of the farmers particularly in the developing countries. Postharvest technology also increase food and nutritional security and alleviate poverty.

Keywords: Postharvest, Fruit, Vegetable, applications, physiology

EFFECT OF SHORT- ROTATION TREES ON NUTRIENT DYNAMICS AND ROOTING PATTERN IN INTERCROPPED WITH AROMATIC GRASSES IN TERAJ OF UP

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An Experiment was conducted in District Pilibhit.U.P., to study the yields of aromatic grasses in pure fields as well as intercrops under *Populus deltoids* and *Eucalyptus hybrid*. Quantity of litterfall, its chemical composition, nutrient addition, changes in chemical constituents of soil and herb and oil yield of *Cymbopogon spp.* were studied under agroforestry systems involving *Populus deltoids* and *Eucalyptus hybrid* with intercrop of Aromatic grasses(*C.winterianus*,*C.martini*,*C.flexoues*). Trees were intercropped with grasses have significantly more diameter and height in comparison to trees planted without intercrops. High herbage and oil yield was recorded in pure fields of grasses than their crops intercropped with trees. Maximum yield was produced by Palmarosa and minimum by Citronella in poplar plantation intercropped. In *Eucalyptus hybrid* intercropped grasses, maximum oil yield was produced by Lemon grass and minimum by Palmarosa. Higher quantity of litter was produced in Palmarosa and lower was produced in Citronella intercropped trees. The litter produced by the intercropped stands had higher NPK contents than pure stands. The concentration

of nutrients in the litter decreased with increasing age of the stands. Similarly, the total addition of nutrients(NPK) through litterfall to the soil increased as the age of trees increased. The maximum addition of nutrients was recorded in the field of trees intercropped with Palmarosa grass while minimum was in trees intercropped with Citronella. The available NPK content of soil under the pure stands of trees was higher than the soil of the intercropped stands. Maximum amount of N and K was found in superficial layer of the soil, which decreased with increasing depth. Most of the phosphorus was accumulated in the soil at the depth of 15-30cm in all the stands. At early ages, the roots of the trees were mostly concentrated near the base of the trees but in the later ages the root system tended to proliferates uniformly around the trees. The total root biomass decreased continuously with increasing soil depth at all the radial distances and under all the age groups. It is clear that there is no completion among the root system with roots of intercrops grown along with Poplar and Eucalyptus

SOURCES OF OUTPUT GROWTH AND VARIABILITY IN PRODUCTION OF CUMIN IN JODHPUR VIS-À-VIS RAJASTHAN

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Cumin production of Rajasthan and Jodhpur were kept a dominant position in Seed spices economy of the country. this study was attempt to present the comparative performance of cumin in Rajasthan and Jodhpur. For drawing a meaningful termination of Agri-Export Zones on cumin production in Rajasthan, the selected study period from 1990-91 to 2018-19 was divided into three sub-periods as Ex-ante Agri-Export Zone (1990-91 to 2004-05), Ex-post Agri-Export Zone (2005-06 to 2018-19) and overall study period (1990-91 to 2018-19). The results of the growth analysis revealed that area, yield and production of cumin in Jodhpur was increased faster than Rajasthan and period-I. In case of instability, the production and yield of this crop in period-II were more instable than other two periods in Rajasthan and Jodhpur. The introduction of high yielding varieties have boosted up production Rajasthan specially in Jodhpur. During period-I the growth of output was contributed mainly due to increasing area under the crop. However, in period-II development of high yielding varieties have positive and significant effect on expanding production in Jodhpur and Rajasthan.

Keywords: Growth analysis; Cumin production; Output growth sources; Instability analysis

SEASONAL AND GRAZING EFFECT ON BIOMASS PRODUCTION AND CARBON STOCK OF A TEMPERATE GRASSLAND IN KASHMIR

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Grazing effect on the biomass production and total carbon stock was assessed in the three prominent seasons. During the study, dry aboveground biomass for all the three seasons was recorded highest 4.15 t ha⁻¹ in summer at protected site and the lowest 0.39 t ha⁻¹ in autumn at grazed site while dry belowground biomass for all the three seasons was also recorded highest 2.85 t ha⁻¹ in summer at protected site and the lowest 0.59 t ha⁻¹ in autumn at grazed site, which was more prone to

overgrazing. However, in the present study, a higher concentration of soil organic carbon was noticed 2.96% in autumn season at the protected site and the lowest 1.15% in summer season at grazed site. Total carbon stock was recorded highest 59.86 t ha⁻¹ in autumn season at protected site and lowest 23.81 t ha⁻¹ in summer season at grazed site. Results of the present investigation have led to the conclusion that overgrazing decreases species diversity, biomass production as well as total carbon stock. Soil carbon stock appears to be a single parameter that can help effectively in prioritizing the area for restoring soil health and grassland productivity.

Keywords: Grassland, grazing, biomass, carbon stock, seasons.

NATURAL RESOURCES CONSERVATION IN KASHMIR

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Due to increasing urbanization, industrialization, the per capita land availability is shrinking day by day. Fresh water constitutes only 2.5% of total water on planet and remaining 97.5% water is the salty water in the ocean. Only 0.40% the fresh water is available in surface and atmosphere. If they are not properly used and well managed, a serious scarcity will result. Therefore, we need to conserve natural resources in judicious manner. Natural resource conservation is the ethical use and protection of valuable resources such as trees, minerals, wildlife, water, sunlight, atmosphere and land along with all vegetation and crops. Some natural resources such as sunlight and air can be found everywhere are known as ubiquitous resources. There are very few resources that are considered inexhaustible these are solar radiation, geothermal energy and air. In 1982 the UN developed the World Charter for Natural resources conservation, which recognized the need to protect nature from further depletion due to human activity. Natural resource conservation is a discipline in the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations. Hence sustainable development can be followed where there is a judicious use of resources which compromises the needs of the present generations as well as the future generations. A successful management of natural resources should engage the community because of the nature of the shared resources the individuals who are affected by the rules can participate in setting or changing them. The right to resources includes land, water, fisheries and pastoral rights. The users or parties accountable to the users have to actively monitor and ensure the utilization of the resource compliance with the rules and to impose penalty. Hence, an urgent need of judicious and rational use of natural resources coupled with appropriate cropping pattern, equitable distribution of water along with adoption of integrated agricultural practices is required so that, it may be available to the future generation.

Keywords: Natural resource, conservation, sustainable development, population.

AN OVERVIEW- DISEASES OF BLACK SCENTED RICE AND POTENTIAL USE OF BIOINOCULANTS.

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Aromatic rice constitutes a small but special group of rice which are considered best in quality. Black scented rice of Manipur, which is commonly known as *Chakhao*, are deep purple coloured and scented. Black rice has various nutraceutical properties with high anthocyanin content. These are rated best in quality and fetch a much higher price than high-quality non-aromatic rice in the international market. Despite their importance, the pace of improvement of this group of rice has been rather slow. In addition to other problems, infection by various foliar diseases was noticed viz. Blast (*Piricularia oryzae*), Brown spot (*Helminthosporium oryzae*), Sheath blight (*Rhizoctonia solani*) and Bacterial Blight (*Xanthomonas oryzae*). They imposed a major threat to production with 10-30% of yield loss, quality as well as ecosystem stability. In the present day, the diseases are mostly controlled by the use of chemicals due to their ease of application. However, use of chemicals poses certain problems such as environmental pollution, residual toxicity and fungicidal resistance. This scenario, therefore calls for an alternative approach for the management of foliar diseases of rice by using bioagents, like *Trichoderma*, *Penicillium*, *Rhizopus*, *Bacillus sp.*, *Pseudomonas sp.*, *Streptomyces sp.*, etc due to their less negative impacts on human and environmental health hazards. They are effective in modulating both growth promotion and disease suppression. Hence, the bio inoculants serve to be the sustainable solution for management of diseases.

Keywords: Aromatic rice, bioagents, bio inoculants, foliar diseases of rice.

GENETIC BIOFORTIFICATION OF RICE: A SUSTAINABLE SOLUTION TO HIDDEN HUNGER

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More than half of the global populations meet its daily caloric requirement from the consumption of rice. Ironically, rice based diet is viewed synonymous to micronutrient malnutrition as rice grain contains insufficient concentrations of essential mineral nutrients required for proper growth and development. Further, the anti-nutrient factor phytic acid affects the bioavailability by chelating the mineral ions. Mineral micronutrient malnutrition especially due to the deficiency of Fe and Zn is affecting almost 3 billion people globally and it is acting as major hindrance in achieving sustainable development goals. Genetic biofortification of the staple foods is the sustainable solution to address the challenge of hidden hunger and rice is the choice crop because of its wider consumption especially in the poor sections of the society in the developing countries. Availability of stable donors and understanding of the genes and genomic regions affecting mineral micronutrient biosynthesis, translocation and grain accumulation are the major pre-requisites for the biofortification programmes. In the present we have characterized a large set of diverse rice germplasm for Fe and Zn content in brown rice and milled rice and identified a landrace accession Karuppunel with exceptionally high Zn concentration of 40.9 ppm in polished rice. The accession showed stable performance under a multi-location trial involving five diverse locations situated at four agro-ecological zones. We have also identified an accession Shah Pasand with low phytic acid content. A subset of germplasm lines including 192 accessions were genotyped using Affymetrix 50K SNP chip and marker trait associations (MTAs) were analyzed through genome-wide association study (GWAS). A total of 38 QTLs affecting Fe, Zn and phytic acid and explaining the phenotypic variance ranging from 2.1% to 53.3% has been identified. The donors and MTAs identified in the study are of critical value in enhancing the mineral micronutrient content and bioavailability in rice and consequently in addressing the global challenge of hidden hunger.

CONSERVATION AND MANAGEMENT OF SOIL AND WATER RESOURCES FOR SUSTAINABLE PRODUCTION

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Soil and water resources are being deteriorated because of various anthropogenic and natural factors. Soil erosion is one of the several major deteriorative process which results in deterioration of the soil. Different control measures should be adopted to guard the soil resources against erosion. Major agents of soil erosion are water and wind. Soil conservation is using and managing land based on capabilities of the land itself, involving the application of the best practices to result in optimum profitable production without damaging the land. These can be accomplished by conservation of soil moisture to reduce its loss, use of the best soil and crop management practices,

reclamation of the problematic soil. Measures to prevent soil erosion can be broadly grouped as mechanical and physical like contour bunding, graded bunding, terracing. Agronomic measures such as vegetative barriers of grasses like *Panicum virgatum*, *Tripsacum dactyloides*, grassed waterways using *Cynodon dactylon*, *Paspalum notatum* etc, strip cropping, mulching, crop rotation, planting of grasses for stabilizing bunds. Besides soil conservation, water conservation is also important to achieve sustainable production. It can be done by adoption of irrigation methods like sprinkler or drip rather than flood irrigation recharge of groundwater, adoption of agricultural practices like zero tillage, conservation agriculture etc. It is important to create awareness about soil and water conservation practices among the farmers in order to achieve optimum production to ensure food security along with environmental sustainability.

Keywords: Conservation agriculture, Sustainable production, Food security, Environmental sustainability

IMPACT OF CROP RESIDUE MANAGEMENT ON CLIMATE CHANGE

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As population is increasing day by day at an alarming rate, the demand for food is increasing in the same order. So, to fulfill this demand, it is important to increase the food production. In India, number of crops are cultivated in different regions leading to production of more than 500 million tons of crop residues annually. In many places these residues are used either for fuel making, livestock feed or are burnt. Burning of these residues on farm leads to emission of many gases like SO₂, NO₂ and CO₂ etc. other than green house gases (GHGs) which ultimately causes pollution, loss of nutrients, soil erosion and death of beneficial soil organisms. The reason behind burning of crop residues by farmers is lack of awareness and technological facilities. Crop residue burning release gases that are not good because it will not only increase the global temperature but also responsible for climate change also. Some implements like happy seeder, hay rake, hay baler are helpful in managing the crop residues efficiently. Crop residues can be managed by incorporating them in soil, utilising them for mushroom cultivation, vermicomposting, fuel or as packing material. Farmers are forced to burn crop residues because of the shortage as well as high wage of labour during harvesting season. So, training and demonstration should be organized for farmers for making them aware of the crop residue technologies so that they can manage crop residues efficiently. Therefore, proper crop residue management helps to increase the crop productivity as well as enhance environmental sustainability.

Keywords- Climate change, Crop residue management, Green house gases, Happy seeder, Vermicomposting

FOLIAR SPRAY OF GLYCINE BETAINE ENHANCES GROWTH, PHOTOSYNTHETIC EFFICIENCY, ENZYME ACTIVITIES, NUTRIENT CONTENTS, STOMATAL BEHAVIOUR AND CELL VIABILITY OF MUSTARD

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Glycine betaine (GB) is a key osmoprotectant. It can be used as an innovative tool in agricultural to improve the growth and productivity of economically important crop plants. GB regulates diverse physio-biochemical processes in plants under normal and stressful condition. A simple randomised pot experiment was designed to explore the effect of leaf applied GB on growth, photosynthetic efficiency, enzymatic activities, mineral nutrient contents, histochemical and microscopic studies of mustard (*Brassica juncea* L. cv PusaAgrani). The plants were sprayed twice with four graded concentrations of GB i.e. 0, 10, 20 or 30 mM at 50 and 70 days after sowing (DAS). The plants were sampled at 80 DAS to assess various parameters. The data showed that the increasing levels of GB upto 20 mM enhanced growth attributes, net photosynthetic rate, stomatal conductance, activities of carbonic anhydrase, nitrate reductase and antioxidant enzymes, and mineral nutrient contents. Additionally, the graded levels of GB upto 20 mM improved microscopic studies (stomatal aperture, root cell viability and root H₂O₂ production) and histochemical studies (superoxide radical and H₂O₂ localization in leaf). No further improvement was noted in the studied parameters after 20 mM GB. It may be concluded that out of various concentration of GB tested, 20 mM proved best for the optimum performance of *Brassica juncea* (L.) cv PusaAgrani.

Keywords: *Brassica juncea*, glycine betaine, photosynthetic efficiency, antioxidant system, histochemistry

MASTHEAL: A UNIQUE HERBAL PRODUCT FOR TREATMENT OF MASTITIS IN DAIRY CATTLE

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Mastitis is a highly prevalent disease in dairy cattle and leads to major economic loss worldwide. It is characterized by inflammation of the udder tissue and the teats of cattle when they come in contact with the environment during the process of milking or due to physical trauma. The causative organisms mainly include *Staphylococcus aureus* and *Streptococcus agalactaceae*. The current treatment modalities include intra-mammary anti-inflammatory or intravenous parenteral antibiotics, oral supplements and topical Medications. Although these are effective, herbal approach may offer a safer, and often an effective, alternative treatment. Our approach was designing a polyherbal, bioadhesive spray and gel of the methanol extract of *Acacia* species pods and *Curcuma* species with the aim of combining the power of anti-inflammatory and anti-bacterial activity in a single product thereby reducing the cost of treatment. To formulate and optimize a polyherbal gel and spray using the selected actives and study their release profile using Franz-diffusion cell. Bioadhesive spray and gel of *Curcuma* species and methanolic extract of *Acacia* species were prepared using polymers such as poloxamer and polycarbophil. Various batches were prepared with the aid of physical mixing by varying the concentration of polymers and the batch was optimized based on the evaluation parameters. Pre-clinical studies for anti-inflammatory activity of *Acacia* species was done on male wistar rats. Anti-bacterial studies against the causative micro-organisms,

in-vitro diffusion studies using porcine skin and in-vitro skin irritation studies by HET-CAM were performed for the final formulations. The bioadhesive polyherbal formulations were compared with a marketed one where it showed enhanced anti-bacterial activity than the marketed one. The optimized batches of both polyherbal spray and gel were evaluated for in-vitro drug diffusion where release of *Curcumin* and *Acacia* in buffer (pH 6.8) was 50% and 38% respectively after 4hrs indicating sustained release. The in-vitro HET-CAM studies revealed no lysis, haemorrhage or coagulation till 5 mins indicating score zero and proving it to be non-irritant. Comparative anti-bacterial studies were done with a marketed formulation containing curcumin against strains of *Staphylococcus aureus* where our formulation gave better inhibitory zone than the marketed one. The efficacy studies were performed on dairy cattle suffering from swollen and inflammatory teats with the consent of in-house veterinarian. The results indicated a significant reduction in inflammation post 5 days of application. This study suggested that a combination polyherbal spray and gel were developed and exhibited a synergistic anti-inflammatory and antibacterial action and could prove to be a simple, easy to use, effective and economical treatment option for mastitis in cattle.

EVALUATION OF THE PERFORMANCES OF NEWLY RELEASED POTATO VARIETIES UNDER AEROPONICS

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Recent developments in automation of minitubers production have further enhanced adaptability of these techniques in potato seed production. In addition to quality assurance through meristem culture, aeroponic technique of minitubers production ensures high multiplication rate at initial stages of quality seed potato production. Five recently released varieties viz., K. Lima, K. Sukhyati, K. Kesar, K. Neelkanth and K. Manik were evaluated for their minituber production potential under aeroponics. All the varieties except K. Manik performed well under aeroponic and on an a/v 35-40 minitubers per plant were harvested. Whereas, variety K. Manik did not perform at all thereby suggesting the further investigation on varietal specific nutrient formulation.

Keywords: Minitubers, Aeroponic, Varieties, Seed

ASSESSMENT OF METEOROLOGICAL DROUGHT IN DAMOH DISTRICT OF MADHYA PRADESH, INDIA

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In rainfed agriculture, rainfall has a crucial role to play for suitable crop planning. One hundred nineteen years (1901-2019) annual rainfall data has been analysed to find out yearly meteorological drought occurrence at Damoh district shows that maximum rain 1874.6 mm is in 1990 and minimum rainfall is 614 mm in 1993. Annual average rainfall is 1196 mm. Based on rainfall analysis, it was found that during 119 years no severe and extreme drought year was experienced. However, there

was 15 moderate drought (1913, 1918, 1941, 1965, 1966, 1987, 1988, 1989, 1991, 1992, 1993, 2006, 2007, 2014 and 2017) and 45 mild drought (1901, 1902, 1903, 1904, 1905, 1907, 1908, 1909, 1910, 1911, 1912, 1914, 1920, 1921, 1924, 1927, 1928, 1930, 1950, 1952, 1953, 1954, 1957, 1964, 1968, 1972, 1974, 1975, 1979, 1981, 1984, 1986, 1995, 1996, 1997, 1998, 2000, 2001, 2002, 2004, 2009, 2012, 2015, 2018 and 2019) years. It was also found that no drought (M0) years which are above the normal average rainfall are 50 %. No of years of different intensities of drought are M1 38%, M2 13 %, M3 and M4 Nil. The decreasing trend in damoh district and coefficient of determination $R^2=0.004$ indicating only 0.4% of the variation in annual rainfall can be explained by the regression model. To reduce the problem of water scarcity in drought years, proper rain water harvesting must be done.

Keywords: Meteorological Drought, Rainfall and Damoh.

IN VITRO EVALUATION OF NATIVE RICE SPECIFIC ISOLATES OF TRICHODERMA AGAINST RICE SHEATH BLIGHT CAUSED BY *Rhizoctonia solani*

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Trichoderma is a free living fungi which are highly interactive in root, soil and foliar environments as well. *Trichoderma* can be used as a biological control agent due to its ability such as mycoparasitism, production of antibiotic and/or hydrolytic enzymes, competition for nutrients, as well as induced plant resistance; production of numerous secondary metabolites inhibitory to the growth of several plant pathogens. In this study, the antagonistic potential of some native rice specific *Trichoderma* isolates were evaluated against sheath blight disease of rice caused by *Rhizoctonia solani*. It revealed that the inhibition percentages of *R. solani* by the native rice specific *Trichoderma* isolated from various soil samples of Manipur ranges from 62.50% to 87.50% with highest per cent inhibition by WAI-D, *T. harzianum* (MH257323), and lowest by LAM-B, *T. brevicompactum* (MH257322) of 87.50% and 62.50% respectively. Bell's scale study showed class III category by *T. brevicompactum* (MH257322) and class II showed by *T. harzianum* (MH257323) against *Rhizoctonia solani*. Among the native rice specific *Trichoderma* isolates, WAI-D, *T. harzianum* (MH257323) is found to be the most effective in reducing the rapid growth of pathogen. Further, all native *Trichoderma* isolates significantly inhibited the mycelial growth of the pathogen.

Keywords: Native *Trichoderma*, Rice Sheath Blight, *Rhizoctonia solani*

RURAL WOMEN EMPOWERMENT THROUGH ECO-TOURISM IN INDIA: A REVIEW FOR POST-COVID-19

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Ecotourism is the tourism involving visiting pristine natural areas intended to create a low-impact and small scale alternative to standard commercial mass tourism leading to conserving and responsible travel to natural areas and improving the well-being of local people. Covid-19 Pandemic has a devastating effect not only among India but the whole world. No doubt, the economy is at a great fall but with this the opportunities are open for the new entrepreneurs, especially when we have natural sources to be used for profit without destroying them. India is a land of varied geography and one of the 12-mega bio-diverse countries having rich cultural heritage has a potential to attract tourists more than anyone's imagination. The Himalayan region, Kerala, the northeast India, Andaman & Nicobar Islands and the Lakshadweep islands are the bird's eyed attractions of India. In Indian traditions, human kind is part of nature but today nature in all its faces has got heavily exploited, specially through global warming and green house effects which are again the outcomes of unnatural activities performed by humans for decades. According to Priyadarshini D (2018), "limited scientific and management focus over developing ecotourism as a viable approach is a key reason why ecotourism has not been successful in India". Women now more than ever to involve in financially benefitting work along with family responsibilities. Now new sources of livelihood need to be approached specially for women so that they can work at homes and at least their local niches. The development of agriculture-tourism, village-tourism and wildlife-tourism in India by identifying the priority needs of the travelers and local communities can make ecotourism a huge success in India. This could provide the local communities with livelihood opportunities like tour guides, accommodations, food supplies, adventure activities, culture experts, craftsmanship, etc. It can solve the issues of rural unemployment, consistent neglect of the agriculture sector and urban migration. The Indian policymakers need to realize that ecotourism can be harnessed to transform the rural economy of the country and bring positive legislation in this regard. Mother earth has given us huge resources which can be used to build economic sustainability along with strict rules towards their protection. Rural women may find opportunities to serve and enrich the curious visitors with their rich local culture. Also this will give a chance to our diverting and emigrating rural population to connect again with the precious land.

Keywords: Women, Empowerment, Ecotourism, Covid-19, Village Tourism.

INFESTATION LEVELS OF SUGARCANE SHOOT BORER *CHILO INFUSCATELLUS* IN CAUVERY DELTA ZONE OF TAMIL NADU, INDIA

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Status of sugarcane shoot borer *Chilo infuscatellus* Snellen (Lepidoptera: Pyralidae) in the sugarcane command area of Pudukottai and Thanjavur districts lying in the Cauvery delta zone of Tamil Nadu, India, was assessed in May and October during 2013-2015. Infestation levels of the borer varied among eight divisions of the command area, two seasons and three years. In May, mean infestation rate was the highest in Vallathirakottai division (44.3%) and lowest in Andakulam division (37.9%).

In October, the highest mean infestation rate was observed in Avanam (38.0%) and the lowest in Andakulam (25.5%). Repeated measures ANOVA indicated that mean shoot borer infestation rate was significantly higher in May (40.8%) than in October (31.24%). Also, mean infestation rate was significantly lower in 2013 than in 2015. The possible factors responsible for the observed variation are discussed.

Keywords: Sugarcane, shoot borer, *Chilo infuscatellus*, status, Cauvery delta zone, Pudukottai, Thanjavur, districts

PRECISION AGRICULTURE, SOIL AND WATER CONSERVATION FOR SUSTAINABLE AGRICULTURE SYSTEM

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Precision Agriculture (PA) can assist in the management of environmentally friendly crop production inputs. Using site-specific information, PA can identify fertilizer, seed and soil chemicals and other conditions. According to the Food and Agriculture Organization (FAO) of the United Nations, the world's population will reach 9.2 billion by 2050. We need new smart ways to grow food and control the use of our land. These include automatic irrigation systems, drones, non-motorized tractors, plant health monitoring and face recognition of cattle. The direct benefits of agriculture on the environment come from highly targeted applications that reduce losses from overuse and reduce the loss of nutrient inequality, weed control, pest damage, and more. Other benefits include reduced development of resistance to pesticides. Conservation of soil and water resources is critical to agricultural and environmental sustainability. Soil erosion is one of several major degradation processes leading to soil degradation. In sustainable agriculture and the environment, it is appropriate to protect soil resources from erosion. Soil conservation practices include soil management, crop management, engineering, spot management, and forestry operations. Sustainable agricultural water management can be achieved by embracing improvements in irrigation applications, land and crop practices, water prices, wastewater management, farmers' participation in water management and capacity building. Moreover, water conservation can be achieved by adopting better water allocation management or improvement in irrigation water efficiency. Hence, there is a need to integrate farming practices that reinforce more knowledge in the right framework to increase farm productivity, profitability and sustainability.

Keywords: Precision, sustainability, soil erosion, irrigation

FARM MECHANIZATION AND POST HARVEST TECHNOLOGIES TO ENHANCE FARM PROFITABILITY

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Farmers face problems in the everyday decision on how to optimize their land use. Such decisions include discrete choices of adopting modern technologies intended to increase farm production and profit. In most developing countries, the adoption rate of such technologies has been low despite the desirable impacts of new technologies. Mechanization of agriculture took place during the 20th

century and led to major changes such as an increase in production, and now demand for mechanization is increasing rapidly. Agricultural mechanization has played a significant role in transforming small scale holders. The principles of planning and financial management help in the development of mechanized agriculture. Mechanized farming covers the relationship between labour and machinery, sources of capital, monitoring cost, cost accounting, taxation, and investment. It also covers the management techniques involved in cost-saving, budgeting, cropping, stocking, labour management and selection of machines.

Another problem faced by farmers is post-harvest food losses; most of the farmers considered a change in weather(40%), field damage(33%) and storage pest(16%) as the three most important factors causing low crop yield. However, the survey has shown that farmers' insufficient knowledge and post-harvest management skills are primarily responsible for food losses. Therefore, increasing farmers' technical know-how on the adoption of farming systems to climate variability and post-harvest management training could reduce food losses and improve poverty and household food security.

Key words: Mechanization, Technical, post harvest management

PHYTOECDYSTEROIDS –PROMISING MOLECULES IN INSECT PEST MANAGEMENT

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Phytoecdysteroids are derived from plants and are analogues to ecdysteroids occurring in insects. The primary role of phytoecdysteroids is the protection of plants against non-adapted insect pests. These phytoecdysteroids when present in insect food, leads to disruption of internal titers of ecdysone and the untimely and altered levels of ecdysone leads to disruptions in insect metabolism, growth and development. Thus, they provide a scope for utilizing interesting molecules for pest management. They have been reported to be present in over 100 families across the pteridophytes, gymnosperms and angiosperms. Phytoecdysteroids have been known to occur in a relatively higher concentration (0.001-3%) in different plant parts. Though, there is no regulation that phytoecdysteroids occur in particular plant parts, majority of the concentration is observed in those tissues which are vital for their survival. Due to their potential in insect pest management (IPM), phytoecdysteroids are attracting renewed attention. Several thousand species of plants have been surveyed extensively for the presence of phytoecdysteroids and over 200 phytoecdysteroids have been isolated in the past thirty years. The literature data and results of several bioassays indicate that various phytoecdysteroids provide plant protection by playing a defensive role against insect pests. The major question thus arising is their feasibility for utilization in crop protection. There is a need for more laboratory and field-based studies. It can be made possible to envision cultivated plants to produce phytoecdysteroids to protect themselves from pest when stimulated. Though phytoecdysteroids are not an alternative for currently used plant protection methods but they characterize stimulating molecules which can have an important part in IPM strategies in the near future.

Keywords: Phytoecdysteroids, insect-pest, plant protection and IPM.

SPECIES COMPOSITION AND RICHNESS IN DIFFERENT SIZED AGROECOSYSTEMS OF INDIAN CENTRAL HIMALAYA, ALONG AN ALTITUDINAL GRADIENT

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The present study has been performed to analyze the plant species composition, species richness (SR), Family Importance Value (FIV), and similarity indices (SI) among different-sized Central Himalayan agroecosystems (AGEs). The AGEs have been divided into three size classes *i.e.* small, medium, and large size class based on the available landholdings among four different altitudes *i.e.* very low (VLA), low (LA), mid (MA) and high altitude (HA). The results revealed that among all the sites a total of 58 plant species belonging to 25 families were recorded within AGEs, out of these, 17 were tree species, 21 herb species were cultivated, 15 herb species were wild and 5 herb species were categorized as wild- cultivated due to the cultivation of wild species for forage purpose. SR was reported as VLA (18) > LA (17) > MA (16) HA > (16) and depicted a positively significant relation with altitudes ($r^2 = 0.607$) whereas it was not affected by AGE sizes. It was observed that the higher altitudes (MA and HA) were proliferated with vegetable-based agroecosystems (*Brassica oleracea var. capitata*, *Phaseolus vulgaris*, *Pisum sativum*, *Solanum tuberosum*, etc.) whereas the grain (*Triticum aestivum*, *Oryza sativa*, and *Zea mays*) and pulse (*Glycine max*) based agroecosystems were common in lower altitudes. The highest FIV was reported for family Poaceae followed by family Fabaceae among all altitudes. Similarity indices among agroecosystem size classes and along altitudes depicted that the highest similarity (48 %) of plant species composition was recorded between VLA- LA, followed by HA-MA (43.90 %).

Keywords: Agroecosystems; Altitude variation; Size variation; Species composition; FIV

BIOREMEDIATION OF BUTACHLOR BY BACTERIAL CONSORTIA FROM POLLUTED SOIL OF ASSAM

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Herbicides, as a tool for weed management are gaining immense popularity as it provides economic, efficient and timely control of weeds. The continuous use of butachlor belong to Acetanilide group used as pre emergence herbicide against grasses and broad leaves weeds commonly in rice fields has called the special attention due to the multifaceted toxicity, persistence of the butachlor molecule in soil and enters finally into the entire food chain. Thus this build up of the butachlor residues in soil affecting the soil microbial community that are primarily involved in the nutrient cycling and crop residue decomposition resulting in the poor soil health. Laboratory pot study was conducted to work out the consequences of bacterial consortia on butachlor treated soil with treatments comprised of T1 – Butachlor @ 1000 g/ha, T2 – Butachlor @ 1000 g/ha, + Vermicompost @ 2 ton/ha, T3 – Butachlor @ 1000 g/ha, + Bacterial consortia @ 10 ml /6 kg soil and T4 – Butachlor @ 1000 g/ha, + Vermicompost @ 2 ton/ha + Bacterial consortia @ 10 ml /6 kg

soil with repetition of four and CRD as the statistical design. Bacterial consortia of (52.32 – 782.4) $\times 10^6$ CFU g^{-1} soil were inoculated to the pots @ 10ml per 6kg soil with 30 % soil moisture content. All together 26 bacterial cultures were isolated, out of which 4 from coal, 8 from petroleum oil, 3 from brick, 5 from cement and 6 from paper polluted soil using specific media. Identification of the bacterial isolates was done by sequencing of 16SrRNA and phylogenetic tree of which most of the bacteria belongs to the strains Bacillus, Pseudomonas, Fictibacillus, Acinetobacter. The treatments (T3 and T4) with bacterial consortia resulted faster degradation with shorter half lives of Butachlor over the treatments (T1 and T2) without bacterial consortia.

Keywords: Butachlor, Bioremediation, Bacterial isolate, Half Life

DOUBLING THE FARMER INCOME THROUGH INNOVATIVE APPROACH

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Now-a-days the population of India is increasing in a sky-rocketing manner and productivity of arable land is still stagnant in present era. Therefore, the challenges are under alarming situation to increase the agricultural productivity in order to feed the growing population. Majority of the Indian farming communities follow traditional practices of agriculture which support their livelihood. Farming in India is often distinguished by small, marginal, and fragmented land holdings (about 86 per cent) and is highly dependent upon the severity of monsoon rains. Operating small holdings is often unfeasible and in this situation, farming is not a profitable business or enterprise. Therefore, there is an urgent need of conversion in agriculture production into combined approach with integrated farming system (IFS) that involves crop cultivation, dairy, poultry, fishery, mushroom cultivation, agro-forestry, piggery, bee keeping, vegetable and fruit production, use of renewable energy source (i.e. Solar energy, Bio gas etc.). For doubling the farmer's income, few vital strategies need to be adopted considering the basic requirements of the farmers. These strategies might be huge investments in agricultural research and development, acceptable adoption of Good Agricultural Practices (GAP), Conservation Agriculture (CA) technology, implementation of farmers' friendly policies, judicious use of available resources and inputs, Site Specific Nutrient Management (SSNM) along with improved market and transportation facility, minimum support price (MSP) reform, supported by adequate and timely availability of bank credits. It has been reported that a rise in MSP will raise farmer income by 13-26 per cent. Smart farming and credit supporting smart farming are other possible approaches in doubling farmer's income. Crop diversification mainly deals with the concerns of high value crops. Economic and socio-ecological access towards sustainable production could only be secured by adopting Farming System Approach (FSR).

Keywords: GAP, SSNM, IFS, MSP, Doubling farmers income

PROTECTED CULTIVATION OF FLOWERS

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Floriculture is a fast-emerging sector growing at a modest rate throughout the world and India has been identified as one of the major forces in the world floriculture scenario (Ghargeet *al.*, 2011). It has emerged as a prominent and an attractive sector in view of high returns per unit area. In present scenario, when looking to the increasing population, climate change, decreasing land holding, increasing pressure on natural resources and high demand of quality produce we are forced to shift towards modern technologies of crop production like protected cultivation. It is the technique of providing favourable environmental or growth conditions to the plants. It is rather used to protect plants from the adverse climatic conditions by providing optimum conditions of light, temperature, humidity, CO₂ and air circulation for the best growth of plants to achieve maximum yield and best quality. In protected cultivation microclimate surrounding the plant body is controlled partially or fully as per requirement of plant (Chandra, 2001). This approach is very helpful for off-season production of vegetables as well as cut flower cultivation under the protected condition and has good potential for increasing the productivity by 3-5 folds over open field condition under varied agroclimatic conditions of the country. Even the unemployed educated youths who are not attracted or interested in traditional agriculture are also showing good interest and can be further motivated for this kind of modern agricultural technologies. With respect to flower crops, this technique has many advantages like blemish-free high-quality product, longer harvest duration, reduce leaching of fertilizers and eco-friendly management of pest, weed and disease. Various types of protected structures are available which are suitable for specific type of agroclimatic zones. Among these, green house, net house shade house, hot beds and cold frames are important for cultivation of ornamentals.

Keywords: Protected cultivation, Cut flowers, Self-employment

CONCENTRATION DEPENDENT EFFECT OF ETHYLENE GLYCOL ON THE STRUCTURE AND STABILITY OF HOLO α -LACTALBUMIN: CHARACTERIZATION OF INTERMEDIATE STATE AMIDST SOFT INTERACTIONS

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The interior of the cell is crowded with different kinds of biological molecules with varying sizes, shapes and compositions which may affect physiological processes especially protein folding, protein conformation and protein stability. To understand the consequences of such a crowded environment, pH-induced unfolding of holo α -lactalbumin (holo α -LA) was studied in the presence of ethylene glycol (EG). The effect of EG on the folding and stability of holo α -LA in aqueous solution was investigated using several spectroscopic techniques. The results indicate that stabilization/destabilization of holo α -LA by EG is concentration- and pH-dependent. Low

concentration of EG stabilizes the protein at pH near its pI. From the results of far-UV CD, UV-visible and ANS fluorescence, intermediate state (MG state) was characterized in the presence of high concentration of ethylene glycol. The results invoke a new mechanism for the formation of MG state identical to active component of BAMLET. MG state of holo α -LA has a direct implication to cancer therapy. MG state of α -LA in complex with specific type of lipid is a novel class of protein-based anti-cancer complexes that incorporate oleic acid and deliver it to the cancer cells.

Keywords:Holo alpha-lactalbumin; macromolecular crowding; protein stability; UV- spectroscopy; fluorescence spectroscopy; circular dichroism; ITC; Protein folding; Protein stability.

ROLE OF HYDROGRAPHICAL PARAMETERS AND ENVIRONMENTAL PERTURBATIONS STEERING BIOINVASION AND BIOHOMOGENISATION OF *Eichhornia crassipes* IN COCHIN BACKWATERS (India).- A REVIEW

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The preliminary study provides an account of the influence of various hydrographic parameters of water body and other environmental issues in the bio invasion and bio homogenization of *Eichhornia crassipes* in Cochin backwaters located in the southwest coast of Kerala, India. The highly diverse and biologically productive Cochin backwaters extends between 9° 40' and 10° 12' N and 76°10'and 76° 30' E bounded by Azheekode at its northern end and Thannirmukkam bund at its southern end. Study of invasion gateway is significant considering the means of control and eradication of such noxious weeds. The situation of bio invasion could get further worsened by its interactions with existing environmental perturbation and persistently changing hydrological parameters due to adverse human interventions. The International Union for the Conservation of Nature has listed water hyacinth as one of the 100 most destructive invasive species of the world. The diversity and distribution of *Eichhornia crassipes* have been influenced by several hydrographic parameters including temperature, salinity, dissolved oxygen and pH. The weed devoured for its aesthetically pleasing appearance has a great history of invasiveness in large number of countries around the globe and harnessing them of its resources. This invasive weed creates severe menace which includes endangering biodiversity, sheltering pests, causing eutrophication, clogging waterways, affecting agriculture and aquaculture, hampering shipping and recreational activities. The recent few years have witnessed tremendous increase in the studies relating phytoremediation aspects of *Eichhornia crassipes* and harvesting bio energy out of weed. Global concern over the infestation of water bodies by this noxious aquatic weed has provided the momentum for researchers and other concerned authorities to find ways to monitor, control and curb the damage induced by its exponential rate of spread. This study forms a preliminary data for further investigations with respect to water hyacinth in cochin back waters.

Keywords:*Eichhornia crassipes*, bioinvasion, bio homogenization, hydrological parameters, cochin backwaters

**CLIMATE CHANGE AND ITS IMPACT ON AGRICULTURE
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Agriculture sector is of the utmost importance to the economy of a country and incidentally it is also most vulnerable to global climate change. Climate change is taking a toll on India's agricultural production and productivity. Intergovernmental panel on climate change (IPCC) has projected that by the end of 21st century temperature in India is likely to increase by 3-4°C which would lead to a loss of 3-26 % in net agricultural revenues. Aggravated climatic factors will ultimately decline plant productivity, which will result in increased prices and unaffordable rates for the common population. The absence of mitigation and adaptation measures may result in lower farm income by 12-40 % in the coming years. This issue is an important concern for livelihood, economic development and ensuring food and job security of an agrarian nation like India. The causes that ultimately are contributing to increase in greenhouse gases, deterioration of soil and water ecology must be identified and rectified. Crop productivity in the countries of southern hemisphere is expected to decrease by as much as 20 per cent, with less developed countries suffering the greatest negative effects according to IPCC report 2007. Hence, adaptation to current agricultural scenario must be undertaken at once to avoid the risks incurred and tackle complications arising due to global climate change. How quickly Indian farmers are able to adjust in their farming practices to adapt to climate change and what policies or technologies will enable rapid adaptation are issues that merit attention of everyone. However, a rapid adaptation is less possible in a developing country like India, where availability to information and capital is limited among the majority of farmers.

Keywords: Climate, food security, mitigation, production, temperature.

**EFFECT OF SOIL AMENDMENTS ON RUNOFF, SEDIMENT LOSS AND SOYBEAN
PRODUCTIVITY IN DEGRADED ECOSYSTEM**

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Surface runoff and erosion are responsible for extensive losses of topsoil and agricultural productivity. Use of soil amendments are resourcing conserving technologies for reducing runoff and sediment yield from soils susceptible to sealing on one hand and improve crop yield on other. Organic and inorganic amendments like gypsum FYM and crop mulches have direct impact in improving soybean yield and quality. An experiment was conducted with combinations of treatments like T1: Control; T2: Recommended Dose of Fertilizer (RDF) (soybean); T3: RDF + FYM (10t/ha); T4: RDF + Mulches (mustard crop residue); T5: RDF + Gypsum; T6: RDF+ Gypsum + FYM; T7: RDF+ Gypsum + Mulches; T8: RDF + Gypsum + Mulches + FYM.

Combined amendment application in T6, T7 and T8 significantly reduced runoff and sediment loss by 30-40% and 52% respectively. Soybean grain yield improved by 20-30% in combined (T6-T8) and sole (T3-T5) amendment application treatments over control plots without amendments. Amendment application had direct role in improving available sulfur status significantly that varied from 4 to 18 ppm where gypsum was applied as amendment. Thus, application of these easily available amendments are economically viable options for farmers in improving mustard yield in degraded lands of semi arid regions.

Keywords: Soybean, runoff, sediment loss, gypsum, crop residue, FYM

TRADITIONAL BONE HEALING FORMULATION OF ASSAM: A STUDY ON ITS PREPARATION AND ADMINISTRATION

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Research showed that around 69% of the Indian population face high risk of bone fracture and suffer continuous bone loss each year and to treat this, people of various tribes belonging to the rural area of India, use different traditional plant-based formulations. This extensive ethnobotanical study was performed to document one of such formulations, mainly used by the traditional healers of Assam (A state of North-East India), and to record the high-valued medicinal plants used by the traditional healer to treat bone-related problems, its preparation and mode of administration. The research was conducted on the basis of interview, documented by the National innovation foundation- India. The healer was awarded by the 3rd national technological innovations & traditional knowledge award belongs to Charaibahi, Pangiria, Jorhat, Assam, and this herbal treatment was practiced for more than 150 years successfully by her family. In brief, 4 plants from 4 different families are used to prepare the formulation by the traditional healers which have tremendous bone healing activity. The most cited plants are *Cissus quadrangularis linn*(Vitaceae), followed by *Vitex nigunda*(Verbenaceae), *Verbesinaprostrata* (Compositae) and *Merremia umbellate* (Convolvulaceae). Leaves and stems are the main part used to prepare the formulation. All these plants are boiled to prepare a solid paste and then administered in the fractured position. The healers consider their herbal formulation knowledge as a family heritage. They were also ordered by their respective forefathers / grandparents not to disclose the information to anyone outside the family except within their household and to lay down certain rules and regulations for the transmission of the information to the next generation. This indicates they were quite aware that this formulation would be used for services of humanity rather than business. Up to the present generation, these rules are strictly followed.

Traditional bone healing knowledge still administered in the various areas of Assam and traditional healers (**Bez** in Assamese) play an important role in the society and in primary health care services. This current study conversely focuses on the need to preserve and document this traditional bone healing formulation and for more future research on the prescribed plants to know its efficiency,

efficacy, toxicology, and safety. This could improve the bone healing property and help to manufacture better drugs with higher biogenic conjugation in the animal body.

**IDENTITY DEVELOPMENT AND ACADEMIC ACHIEVEMENT OF ADOLESCENTS:
GENDER DISPARITY**

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Adolescence period is very important period of one's life. Adolescents with a clear sense of self and identity tends to be better in identifying their hidden potential and talent which ultimately helps them to excel in their academics too. The present study aims to explore the identity development and academic achievement of Dharwad PUC (Pre-University College) students and influence of gender on each of these two factors. Sample of the study included 312 urban and rural PUC students (16-18 years) who were randomly selected from four science coaching institutes of Dharwad taluk. Purposive sampling was carried out that included a random selection of 10 to 15 per cent students from each class summing up to a total of 156 students each from PUC-I and PUC-II classes of selected science coaching institutes. Rural samples comprised of those students, who had completed their school education till Class-10th in their village and had come for PUC studies in coaching institutes of Dharwad located in urban area. Differential and correlational research designs were used to know the difference and relationship between identity development and academic achievement of PUC students by their gender. Dimension of identity development scale and percentage of marks obtained by the students in their previous class were used to assess their identity and academic achievement. The results of the present study revealed that, majority of urban and rural Dharwad PUC students were in average (61.25 %) and low level (51.97 %) of identity development respectively. A significant gender difference in identity development of urban PUC students was observed where, girls scored significantly higher mean value (92.99) than boys (84.75). However, no significant association and difference between gender and identity development of rural PUC students was found. With respect to academic achievement, higher percentage of urban (60.62) and rural PUC students (61.84) were in excellent and average level of academic achievement respectively. In both urban and rural areas, girls had higher academic achievement than boys.

Keywords: Identity development, Academic Achievement, Gender and PUC students.

**PHYTOCHEMICAL INVESTIGATIONS AND ANTIBACTERIAL ACTIVITY OF
TRADITIONAL MEDICINAL PLANT *Ziziphus rugosa* Lamk.**

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Ziziphus rugosa (Rhamnaceae) is found in semi-evergreen forests of Western Ghats, India. This plant is traditionally used in many formulations with different parts reported to be used in the treatment of skin diseases, mouth ulcer, dropsy, boils, diarrhea, tachycardia, syphilis, miscarriage, misconception, flatulence, hysteria. To conduct phytochemical investigations and bioactivity studies on the leaves of *Z. rugosa*. Successive extracts of *Z. rugosa* leaves were prepared using petroleum ether (60-80°C), toluene, dichloromethane, ethyl acetate, methanol and water by Soxhlet extraction method. The methanolic extract of the leaves was used to prepare alkaloid rich fraction (ARF) as per reported method and the total alkaloid content determined by UV-Vis spectroscopy. The extracts and the ARF were evaluated for antibacterial activity using a panel of gram positive and gram negative strains using ciprofloxacin as the reference standard.

Phytochemical analysis of the extracts indicated the presence of alkaloids, saponins, flavonoids, glycosides, tannins and phenolics. The antimicrobial screening of extracts indicated the extracts to exhibit concentration dependent inhibition of the test bacterial strains. The ARF exhibited the best activity better than the solvent extracts across the panel of bacteria tested. The methanol and water extract showed moderate activity while the dichloromethane and the ethyl acetate extracts were weakly active. This study reports antibacterial activity of the leaves of *Z. rugosa* with the alkaloid rich fraction being the most active. This provides a connecting link between the phytoconstituents, the observed bioactivity and traditional use which warrants detailed investigations on this plant leading to isolation and identification of new actives from this plant of immense traditional utility.

Keywords: *Ziziphus rugosa*, Rhamnaceae, Antibacterial activity, alkaloid rich fraction, solvent extracts

**PHYTOCHEMICAL AND ANTIOXIDANT STUDIES OF *Litsea ghatica*, AN ENDEMIC
PLANT FROM WESTERN GHATS OF INDIA**

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Litsea ghatica C.J. Saldanha belongs to evergreen family Lauraceae and is endemic to the Western Ghats of India. Our laboratory is working on this plant since 2018 with very encouraging results on its bioactivity spectrum. There are no reports on this plant in published literature till date and this is our efforts on harnessing nature to provide substantial benefits in disease management and open up alternatives in diverse areas of therapeutics. The objective of this study was to conduct

phytochemical studies of this plant in an effort to identify potential secondary metabolites and subsequent bioactivity studies based on the nature of secondary metabolites found to be present. Phytoconstituent enriched fractions of *Litsea* were prepared from the methanol extract using reported methods. The total phenolic and flavonoid content of solvent extracts and flavonoid rich fraction of the bark of *Litseaghatica* was estimated using Folin-Ciocalteu and aluminium chloride spectrophotometric assays respectively. The antioxidant activity of these extracts and the flavonoid rich fraction was evaluated using 2, 2-diphenyl-1-picrylhydrazyl radical scavenging and nitric oxide assays. The total phenolic and flavonoid content was found to be 314.18 GAE/gm and 369.95 ± 8.281 QEmg/gm of the flavonoid rich fraction. The methanol extract exhibited potent antioxidant activity, better than the reference standard (quercetin) used in the DPPH assay and nitric acid assay. This is the very first report on the endemic plant *Litseaghatica* and provides an overview of the phytochemistry profile of this plant along with quantification of selected secondary metabolites (phenolics and flavonoids). The flavonoid rich fraction was found to exhibit potent antioxidant activity and this provides a research platform to evaluate its potential application in those diseases wherein reactive oxygen species plays a major role in the pathophysiology.

Keywords: *Litseaghatica*, Lauraceae, Antioxidant activity, Flavonoid rich fraction, Phenolic content, Flavonoid content

OPTIMIZATION OF MICROWAVE PUFFING PROCESS FOR PREPARING READY-TO-EAT SNACK USING COMPOSITE MILLET FLOUR.

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The puffed product from composite millet flour based RTE food was developed by preparing strip type cold extrudates and puffing it using microwave powers for varied time. The composite millet flour was the basic ingredients for preparation of puffed product. The optimal microwave puffing of the steamed cold extruded could be conducted by convective heating at 190 °C for 180 s followed by microwave heating with 80% of total power of 1350 W for 240 s. The microwave puffed product at the optimal process condition having moisture content of 0.2678 kg/kg dm, hardness 156.2, crispness 20 (+ve peaks) and expansion ratio 2.204 and colour found to be 40.43.

Keywords: RTE, snack, puffing, microwave, millet, extrusion

NOVEL NUCLEOTIDE VARIATIONS IN HSPB6 GENE AND THEIR ASSOCIATION WITH HEAT TOLERANCE TRAITS IN INDIAN SAHIWAL CATTLE

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Heat shock proteins (HSPs) act as a chaperone activity ensuring the folding, unfolding, and refolding of denatured proteins, which helps in a protective role during heat stress in dairy cattle. This study aimed to detect novel nucleotide variations of the HSPB6 gene and to determine their association with heat tolerance traits in Sahiwal cattle. Direct sequencing was used to identify novel single nucleotide polymorphisms (SNPs). Three novel SNPs (SNP 1-3) were reported for the first time in 100 multiparous lactating Sahiwal cattle, which included two transitions viz. SNP1-g.436G>A (Intron 1) and SNP2-g.2152A>G (3'-UTR) and one transversion viz. SNP3-g.2417A>T (3'-UTR). Further, Association analysis revealed that the only two SNPs loci viz. SNP1-g.436G>A and SNP2-g.2152A>G were found to be significantly associated with heat tolerance traits (RR, RT, and HTC) in Sahiwal cattle. The association analysis of four available haplotypes viz., Hap1 (GGA), Hap2 (AAA), Hap3 (GAA), and Hap4 (AAT) of HSPB6 gene with RR, RT and HTC in Sahiwal cattle did not differ significantly with any haplotypes. The GG genotype of SNP1-g.436G>A and SNP2-g.2152A>G loci had a significant association with heat tolerance traits, which demonstrated that the genotype GG was superior to other genotypes in Sahiwal cattle. This study provides the first association analyses between the SNPs of HSPB6 gene and heat tolerance traits in Sahiwal cattle, which could be used as effective SNP markers in genetic selection for heat tolerance in cattle breeding program.

Key words: Heat stress, Heat shock protein B6, SNP, Haplotype, Sahiwal cattle

THRIPS PEST (*Thrips tabaci*) INFESTATION ON SOM PLANT LEAVES (*Machilusbombycina*) AND SUSTAINABLE MANAGEMENT USING PHYTO-CHEMICALS

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Som plant (*Machilusbombycina* King) is an important plant in agroforestry system. It is cultivated in north-east part of India in warm humid climate. It is cultivated in agricultural land by the marginal farmers of these areas for multi-storeyed cultivation and income. Localized small/cottage industries are involved with this plant like sericulture industry (muga silk worm cultivation). Clothes are produced from this sericulture industry. Leaves of som plants are major food of muga silk worm. The plant also has timber value. Due to attack of insect pest, it becomes difficult for the farmers to conduct rearing. The plant is susceptible to various insect pests of which Thrips (*Thrips tabaci* L.) causes heavy damage to tender leaves of the plant. Thrips was active throughout the year. Lower population was recorded during 3rd week of March to last week of June and higher population was during last week of November to 3rd week of January. Peak population (12.77/3 leaves) was recorded on 49th standard week i.e., 1st week of December. Thrips population had significant positive correlation with relative humidity (maximum) while significant negative correlation with temperature. This indicates that activity of thrips population increases with the rise of relative humidity and decreases with the rise of temperature. Under the present investigation Imidaclopride pesticide was found most effective against thrips providing 75.18% suppression closely followed by Azadirachtin, 64.94% suppression. It was revealed that extracts of Garlic, tobacco, *Spilanthes* and *Polygonum* plant gave moderate results, recording about 53.33%, 48.55%, 47.24% and 46.71% thrips suppression respectively. The polygonum (*Polygonum hydropiper*) plant (floral parts), pongamia (*Pongamia pinnata*) leaves, garlic (*Allium sativum*), spilanthes (*Spilanthespaniculata*) (floral parts) were extracted in methanol. The tobacco (*Nicotiana*

tabacum) leaves were extracted in water. Imidaclopride is a highly toxic synthetic insecticide and so there is every possibility to contaminate some plant leaves with the toxic chemicals, as some leaf is the major food component of muga silk worm rearing. Plant extracts are of biological origin having low or no hazardous effect on environment and so can be incorporated in Integrated Pest Management (IPM).

Keywords: Incidence, climatic factors, muga silk, plant extract, environmental sustainability

PERSONAL, SOCIO-ECONOMIC AND PSYCHOLOGICAL STATUS OF WOMEN ENGAGED IN SERICULTURE

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Sericulture is a labour-intensive agro-based activity and is also an industry (Kasi, 2013). Sericulture is of great importance in many countries in providing gainful employment, economic development and improvement in the quality of life of rural people. It suits both marginal and small-scale land holders since it is of low investment, has high assured returns and short gestation period and provides opportunities for enhancement of income and creation of family employment round the year. It also plays a major role in anti-poverty programmes and prevents migration of rural people to urban areas in search of employment. The present study was undertaken during the year 2017-2018 in Imphal West, Manipur to investigate the personal, socio-economic and psychological status of women engaged in Silk Industry. A total of 150 respondents were selected for the study through snowball sampling technique. The selected respondents were interviewed personally using a pre-tested well-structured interview schedule. The study revealed that majority (57.34%) of women respondents were found as middle age group (42-57 years) followed by 29.33 per cent old age group (above 57 years) and 13.33 per cent young age group (below 42 years). Majority (34.66%) of women respondents were illiterate followed by primary to class-V (31.34%), high school (14.00%), can read and write (11.33%), intermediate (6.00%), B.Sc (2.67%) and lastly no respondents were found to be educated up to M.Sc and PhD and above. It was found that 59.33 per cent of women belonged to the large family (6 and above members) and 40.67 per cent belonged to the small family (1-5 members). It was reported that 66.00 per cent of the respondents owned a size of land below 1ha, and 34.00 per cent owned a medium land. No respondent owned a land size of more than 2ha. 72.67 per cent of women had low training exposure, 22.00 per cent had medium exposure and 5.33 per cent had high exposure. Out of the total 150 respondents majority (79.34%) had medium decision making ability, followed by high (11.33%) and low (9.33%).

Keywords: Sericulture, snowball sampling, interview schedule.

STABILITY ANALYSIS OF LENTIL GERMPLASM ACROSS YEARS AND ENVIRONMENTS IN LOW INPUT CONDITIONS IN MEGHALAYA
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A set of 164 lentil germplasm lines were planted in the first season viz., 2013-14 in CPGS upland farm whereas, in the second season viz., 2014-15 at two different locations i.e., ICAR farm (slightly normal pH) and CPGS upland farm (acidic pH) over which comprised the three environments. The experiment was repeated in three seasons to compare the seedling survivability, yield score and growth parameters over time and space. The germplasm lines were grown in augmented design having 5 blocks with 33 genotypes in each block. Four checks NDL-1, PL-6, PL-8 and Moetre were replicated in each block to estimate the standard error for statistical analysis of ANOVA. The field data were recorded on the following 15 significant parameters viz., plant height (cm), root length (cm), number of primary branches, number of secondary branches, height of lowest pod, no. of pods per plant, pod weight (g), root weight (g), shoot weight (g), harvest index, 100 seed weight, seed diameter (mm), seed thickness (mm), days to 50% flowering and days to maturity. The performance of genotype-environment interactions indicates the buffering capacity of the line or population. The Statistical analysis of ANOVA for augmented design were carried out for analysis of variance in germplasm screening in augmented design and assessing genotype \times environment interaction (GEI). From the stability analysis of the three environments genotypes IPL-322, IPL-325, IPL-220, IPL-324, LRIC-560812, LRIC-569608, LRIC-559871, LRIC-201700, SKUAL-2-96, PL-101, DL-10-01, DPL-62 and PL-04 recorded significantly higher mean with $b_i = 1$ and $S^2_{di} = 0$ for pod yield, number of pods per plant, root weight and plant height indicating that these genotypes are suitable for growing in all the three environments.

Keywords: Lentil, Germplasm, Pod weight, Genotype-environment interaction.

THE EFFECT OF INTEGRATED MANAGEMENT OF ROOT KNOT NEMATODE (*Meloidogyne* spp.) ON TOMATO UNDER PROTECTED ENVIRONMENT

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A pot culture experiment was conducted during the *Rabi* season (2019-2020) under polyhouse conditions in Dr. PCAU, Pusa, Bihar, India. Efficacy of ten treatments including bio control agents viz., *Pseudomonas fluorescens* (5g/pot), *Trichoderma viride* (5g/pot), neem cake (25g/pot), and carbofuran 3G (10g/pot) against root-knot nematode *Meloidogyne* spp. on tomato cv. Heemsohna was evaluated by individual applications as well as in combination. The treatments were arranged in a Completely Randomized Design (CRD) with three replications. Among the different combination of treatments, *Trichoderma viride* + neem cake (5 + 25 g/pot) and *Trichoderma viride* + carbofuran 3G (5 + 10 g/pot) were the most effective treatments on achieving lesser root galls, eggs and egg masses (Root-knot index < 1) and the reproduction factor was found to be 0.39 and 0.40 respectively. *Trichoderma viride* and neem cake significantly suppressed the nematode population and promoted plant growth. Therefore *Trichoderma viride* + neem cake (5 + 25 g/pot) and *Trichoderma viride* + carbofuran 3G (5 + 10 g/pot) combination effectively reduces nematode population and enhances plant growth in root knot infested areas of Bihar, India.

Keywords: Root knot nematode, integrated management, tomato, polyhouse

UNDEREXPLOITED VEGETABLE CROPS AND VEGETABLE LEGUMES FOR NUTRACEUTICAL AND BIOACTIVE HEALTH COMPOUNDS

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There are approximately over 600 species that comprise the global diversity in vegetable crops, but barely one fourth is utilized as a major vegetable crops and rest are named as minor, underutilized, rare vegetables or wild edible vegetables. Some of the underutilized vegetables commonly used in Indian context are Amarnathus (*Amranthus tricolor*), *Basella* spp. (*Basella alba*, *Basella rubra*), Pointed Gourd (*Trichosanthes dioica*), Gherkin (*Cucumis sativus* var. *anguria*), Ivy Gourd (*Coccinia grandis*), Sweet Gourd (*Momordica cochinchinensis*), Karchikai (*M. cymbalaria*), Drumstick (*Moringa oleifera*), Elephant foot yam (*Amorphophallus campanulatus*), *Nymphaea* spp, *Nelumbo nucifera*, Clove bean (*Ipomoea muricata*), Winged bean (*Psophocarpus tetragonolobus*), Sword bean and Jack Bean (*Canavalia gladiata* & *Canavalia ensiformis*), Velvet bean (*Mucuna pruriens*), Tree Bean (*Parkia roxburghii*), Adzuki bean (*Vigna angularis*), Rice bean (*Vigna umbelata*), Aerial yam, Air potato (*Dioscorea bulbifera*) and Chow-Chow (*Sechium edule*). Underutilized vegetables are rich in vitamins, minerals and other health promoting factors including high antioxidant activity. They play a major role in the diversification of diet leading to more balanced source of micronutrients. Underutilized vegetables play an important role in the life of rural people; they form an important part of food and nutrition of local population as many of them have been well-accepted in their cultures for their usage in terms of medicinal, therapeutic and nutritional values since ages and are consumed either as raw or as cooked vegetables as traditional delicacies. Malnutrition and subsequent food shortage among the poor rural population are conspicuous which can be alleviated to a commendable extent by tapping nutraceutical potential of the underutilized vegetable crops. As source of essential vitamins, micronutrients, protein and other phytonutrients, traditional vegetables and underutilized vegetable legume crops such as many beans have the potential to play a major role in strategies to attain nutritional security. Underexploited legumes can be a cheap substitute of protein and can lessen protein malnutrition among preschool children in rural areas. Nutritious pods of *Parkia roxburghii* are consumed as staple legume vegetable in the NEH region of the country. A massive collection of leafy vegetables comes under the category of minor vegetables, which are rich in vitamins, minerals, fibres and can add variety in the diet. Moreover, they form a traditional part of cropping systems, chiefly in kitchen gardens. Except for the leafy vegetables, most underutilized vegetables have longer shelf life. Underutilized vegetables can, thus, make an impact on the dietetic status of population, though they are usually neglected in comparison to other major cereal and vegetable crops. They are generally low in energy and dry matter content, but a vital as source of protective nutrients and thus well equipped to fight against several disease and have become immensely important in the scenario when the life style diseases like diabetes and hypertension have become epidemic. Nutraceutical feature of some of the minor vegetables have the enormous potential to develop immunity in the human body which is very much required in the present covid-19 pandemic situation. Thus regular usage of neglected and underutilized vegetables is an effective way to help maintain diverse and healthy diet and to combat micronutrient deficiencies or the hidden hunger, as well as some other dietary deficiencies.

IMPACT OF COVID-19 ON HUMAN HEALTH AND INDIAN ECONOMY

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In present scenario, COVID-19 has drastically affected the entire population around the world. Its first case was found in Wuhan, China in December, 2019. In India this coronavirus become active in January 30, 2020, when a student traveled from Wuhan, China. He has successfully recovered from this infection on February 14, 2020. In India as of June 11, 2020 about 3, 05,951 persons were infected, out of which 1, 52,395 recovered and 1, 44,838 were still active along with 8718 deaths. This virus belongs to family Coronaviridae and infection mostly starts with respiratory discomfort. Still there is no medicine or vaccine available to cure this infection. Therefore, follow safety precautions and proper hygiene is only the way to keep a person healthy. Due to this pandemic, a lockdown of about 70 days was put by the Indian government. As a result all the industries, business and developmental activities remain closed and economy of India is drastically affected. In this review paper, a discussion has been made on the impact of COVID-19 on human health and Indian economy. These two issues (human health and Indian economy) are of great concern in the present scenario.

Keywords: COVID-19, human health and Indian economy.

HEREDITARY ANALYSIS OF QUANTITATIVE TRAITS IN TEN CULTIVARS OF *Abelmoschus esculentus* (L) MOENCH

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In agriculture technology, ten quantitative traits of 10 genotypes of okra (*Abelmoschus esculentus*) were explored with a view to recognizing the high yielding capability of the cultivars and to conclusive the degree of relationship among their contributing attributes. The plant materials utilized are named by their genotypes as follows: EC169420, EC169430, EC169435, EC169453, EC169462, EC169464, EC169468, EC169470, EC169474 and EC169477. Applying the Randomized Complete Block Design (RCBD) with three replications, the ten genotypes of okra were grown (one seed for each slope) at Research Farm of the Ch. Charan Singh University, Meerut, India during the rainy period of 2019 and 2020. At the proper phases of development, the accompanying attributes were explored: days to blooming, tallness at blossoming, number of pods per plant, pod length, pod width, number of branches per plant, days to maturity, number of seeds per pod, weight of hundred seeds and last plant height. Information gathered were exposed to Analysis of Variance (ANOVA) and phenotypic and genotypic relationship investigations registered. Results show that there is a strong relationship between pod length and pod width with the association of number of seeds per pod. Hence, selection programme dependent on these qualities are well on the way to achieve further improvement in the yield of okra under rainfed conditions.

Keywords: Quantitative traits, ANOVA and RCBD.

EFFECT OF FERMENTED LIQUID FEED ON GROWTH, NUTRIENT DIGESTIBILITY AND ECONOMICS OF GROWER-FINISHER LARGE WHITE YORKSHIRE PIGS

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The study was conducted for assessment of growth, nutrient digestibility and economics of LWY grower-finisher pigs fed fermented liquid feed compared to pigs fed dry feed and non-fermented liquid feed under intensive system of management. Twenty four piglets (42-days of age) were homogenously divided into 4 groups (3 males and 3 females in each group) and assigned one of the four dietary treatment: Basal ration as dry feed (DF), non-fermented liquid feed (NFLF), fermented liquid feed prepared with *Lactobacillus acidophilus* ($1-2 \times 10^9$ cfu/g) (FLF-LA), fermented liquid feed prepared with *Enterococcus faecium* ($1-2 \times 10^9$ cfu/g) (FLF-EF). The feeding trial was conducted for 180 days. The growth performance of the pigs was assessed as fortnightly body weight gain and gain: feed ratio. For determining nutrient digestibility, two feeding trials – at the end of growing and finishing period were conducted. The economics in terms of feed conversion efficiency and feed cost per kg gain in body weight were calculated at the end of feeding trial. Both the average body weight and body weight gain at the end the feeding trial were observed to be significantly ($P<0.05$) higher in FLF fed-groups than the DF and NFLF. During growing period, the digestibility of CP, EE and NFE was significantly ($P<0.05$) higher in FLF fed-groups than the liquid feed group. For CP and EE, highest digestibility was found in FLF-EF, for NFE in FLF-LA. However, during finishing period, except for CP digestibility, there was no significant difference for other nutrients, but positive trend was noticed in FLF groups. The FCR at the end of feeding trial was calculated as 3.82 ± 0.07 , 3.64 ± 0.05 , 3.36 ± 0.04 and 3.46 ± 0.07 , respectively for DF, NFLF, FLF-LA and FLF-EF indicating significantly better FCR in FLF fed-groups. The feed cost/kg gain in body weight (Rs./kg) was calculated as 128.36 ± 2.82 , 120.43 ± 1.67 , 112.87 ± 2.26 and 115.51 ± 1.96 , respectively for DF, NFLF, FLF-LA and FLF-EF, respectively, which indicated significantly reduced feeding cost/kg body weight gain in FLF fed-pigs compared to DF and NFLF. It was concluded from the findings that fermented liquid feed (feed water ratio 1:2) with *Lactobacillus acidophilus* or *Enterococcus faecium* (average $1-2 \times 10^9$ cfu/g) might be recommended for grower-finisher Large White Yorkshire pigs over the traditional dry and liquid feed for optimal growth and efficiency.

Key words: Fermented liquid feed, growth, digestibility, economics, pig.

EFFECT OF DIFFERENT CONCENTRATIONS OF GROWTH REGULATORS ON SHOOTING CHARACTERS OF KARONDA CULTIVARS

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The experiment entitled “Studies on propagation through semi hard wood cuttings in karonda” was carried out at College of Horticulture, Dr.Y.S.R. Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari District. The semi hard wood cuttings of karonda cultivars viz., pink-fruited plants and green-fruited plants were treated with different growth regulators treatments (IBA and NAA) along with control and the experiment was carried out in Factorial Randomised Block Design with 3 replications comprising 14 treatment combinations. The experiment results indicate that among cultivars, semi-hardwood cuttings of green fruited plant performed better than semi-hardwood cuttings of pink fruited plant with respect to shooting parameters like days to first sprouting (3.81 days), number of shoots per cutting (3.02), length of longest shoot (2.63 cm, 6.32 cm and 11.67 cm at 30, 60 and 90 DAP respectively), number of leaves (2.60, 4.32 and 37.85 at 30, 60 and 90 DAP respectively) and leaf area per cutting (287.83 cm²). Among growth regulator treatments, IBA @ 8000 ppm was found best for the parameters days to first sprouting (3.61 days), number of shoots per cutting (3.46), length of longest shoot (4.18 cm, 9.71 cm and 14.52 cm at 30, 60 and 90 DAP respectively), number of leaves (3.38, 4.82 and 42.37 at 30, 60 and 90 DAP respectively), leaf area per cutting (322.16 cm²) and in case of interaction effects it was found that the semi-hardwood cuttings of green fruited treated with IBA @ 8000 ppm was observed to be significantly superior with respect to above shooting parameters.

Key words: karonda cultivars, growth regulators, IBA, NAA

SEROPREVALENCE OF BRUCELLOSIS IN OCCUPATIONAL WORKERS IN BRIJ REGION OF UTTAR- PRADESH

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A total of 509 human serum samples (394 male and 115 female) was taken from different occupational categories. All the samples were processed to detection of prevalence of brucellosis by RBPT and ELISA. Out of 509 human serum sample, the prevalence of brucellosis in 394 male was found to 03.04% (12/394) and 04.06% (16/394) shows positive by RBPT and I- ELISA respectively. In female 115 tested serum sample, the seroprevalence was found to be 01.73% (2/115), 03.47% (04/115) and 02.60% (03/115) positive by RBPT, STAT and I- ELISA respectively. The seroprevalence of brucellosis to different occupational categories may have major public health significance. It is recommended that good management and hygienic practices shall be performed during handling of animals, food items and other suspected materials.

Keywords: Occupational workers, Serum, RBPT, I- ELISA, PCR

DYNAMICS OF ORGANIC INPUTS ON SOIL HEALTH, YIELD AND QUALITY OF CROPS UNDER CERTIFIED ORGANIC FARMS IN NAGPUR DISTRICT

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The field investigation in relation to "DYNAMICS OF ORGANIC INPUTS ON SOIL HEALTH, YIELD AND QUALITY OF CROPS UNDER CERTIFIED ORGANIC FARMS IN NAGPUR DISTRICT" was carried out during kharif-rabi season of 2018 - 19 at the certified organic farmer's fields of Nagpur district to assess the soil properties, quality and yield of different crops as influenced by various organic resources. Soil samples of 0-20 cm depth were collected randomly after the harvest of crops from six locations viz., Selu, Kalmeshwar, Gangner, Saoner, Chacher and Chinchbhavan of Nagpur district were selected for recording various observations and collected plant samples for quality parameters. Yield of crops was noted from farmer's field of above locations. The certified organic farmers applying FYM @ 2.5 to 10 t ha⁻¹, Ghanjivamrut 500 kg ha⁻¹ and Jivamrut 500 lit ha⁻¹ from last 8 to 18 years for different crops. The results revealed that soil pH was reduced due to continuous application of various organic sources to field. However, electrical conductivity of soil (0.254 to 0.497dS m⁻¹) remained almost unchanged due to incorporation of organic and inorganic sources. The application of organic inputs increased organic carbon by 7.24 to 61.80 per cent at different locations over fertilizer applied field. The bulk density of soil decreased and hydraulic conductivity and water holding capacity increased by 2.87 to 18.72 per cent due to long term effect of various organic sources. The application of organic sources from 8 to 18 years resulted in maximum available N content of soil by 14.61 to 64.57 per cent over the application of fertilizers alone. The available P content of soil after harvesting of crops varied from 12.09 to 25.56 kg ha⁻¹ and comes under medium to high range categories. The application of organic sources from 8 to 18 years increase soil available potassium by 2.16 to 15.37 per cent over inorganic. The variation in available sulphur (10.64 to 15.38 mg kg⁻¹) was observed and it found low to moderately high amount in all locations. The use of FYM, manurial liquid and solid organic source was found useful in maintaining the available micro-nutrient status of soil over the continuous use of fertilizer. The maximum microbial count was recorded in organic field over the inorganic field. The count of bacteria, fungi and actinomycetes were varied from 15.75 to 25.0 X 10⁷cfu g⁻¹, 9.0 to 15.75 X 10⁵cfu g⁻¹ and 7.50 to 14.75 X 10⁵cfu g⁻¹ respectively. The quality of crops was improved with application of organic inputs over the fertilizers application. The protein per cent of different crops was found maximum in organic field. The oil percent was recorded nearly same in the organically and inorganically grown crop. From the study it can be concluded that, the application of organic inputs improve the physical, chemical, biological properties and fertility status of soil. In case of yield due to organic sources decreased but quality improve.

ERGONOMIC EVALUATION OF WOMEN FRIENDLY AGRICULTURE TOOLS

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Agriculture sector employs 80 per cent of all economically active women in India, they comprise 33 per cent of the agriculture labour force and 48 per cent of the self-employed farmers. In India, 85 per cent of rural women are engaged in agriculture, yet only about 13 per cent own land. Women are considered as invisible labour in fields. However, they spend their time in managing both field work as well as domestic chores. Moreover, women in agriculture perform physically strenuous task though atomization has knock the door of Indian agriculture. Conversely, as an occupational environment, regardless of the technological advances, agriculture is regarded as one of the most demanding and hazardous sectors. There are numbers of occupational risk appearing in farm workers and musculoskeletal disorders one of the widespread. The intensive work perform by women workers in repetitive movement with adopting awkward posture and poor agriculture tools are tasks associated with the main risk factors regarding the reported musculoskeletal disorders. In context to the above assertion hence, there is not only a need to work on designing women friendly agriculture tools but also impart training and awareness among women agriculture workers that they should work with tools that are designed based on ergonomic aspects.

Keywords: Women, Agriculture, Tools, Ergonomic, Musculoskeletal disorders.

FARMER'S KNOWLEDGE LEVEL TOWARDS COOLING METHOD AND TEMPERATURE, STORAGE AND PACKAGING OF VALUE ADDITION IN HORTICULTURE AND VEGETABLE CROPS

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The present study was conducted in Haryana state and two districts Hisar from southwest and Sonipat from northeast were selected, purposively. From each district, three blocks were selected randomly. Further, three villages were selected from each block making a total of 18 villages. From each village, ten farmers were selected randomly, making a total sample of 180 farmers. It was found that majority of the farmer 62.78 per cent had medium level 26.11 per cent had high and 11.11 per cent had low level of knowledge regarding 'Room cooling: placing the crops in cold storage'. The study revealed that majority of the farmers 71.11 per cent possessed medium level while only 28.88 per cent high level of knowledge about of preserve crop produce to consume in off season and 66.11 per cent had high level, 33.89 per cent had medium level of knowledge regarding 'Flexible sacks: Made of plastic jute, such as bags (small sacks and nets made of open mesh)', not even a single respondent was found to have low level of knowledge of it. It was found that majority of the farmer 65.56 per cent had high level 32.78 per cent had medium and 1.66 per cent had low level of knowledge regarding 'Cleaning: chemical must be removed from produce before packing. e.g. Insecticides, pesticides etc'. To reach the results aggregates total was calculated for each statement separately and on the basis of calculated scores, mean scores and mean score percentage were obtained which were ranked according to their maximum to minimum mean score percentage for assessing the knowledge level of the farmers.

Keywords: Cooling, Temperature, Knowledge, Cleaning, Insecticides, Pesticides

ASSESSMENT OF FARM POWER AVAILABILITY IN ALL 9-AGRO-CLIMATIC ZONES OF UTTAR PRADESH

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Uttar Pradesh is situated in northern India. The population of the state was about 200 million as per census of 2011, The gross area of the Uttar Pradesh is 24.2 million hectare, out of which 16.68 million hectare is the net sown area. The average size holding per farmer was only 0.83 ha. Farm power is an essential input in agricultural production system to operate different types of equipment for timely field completion of agricultural works to increase productivity and maintain sustainability of farm. The mobile power is used for different field jobs like land preparation, sowing, weeding, spraying, and harvesting etc., whereas stationary power is used for lifting water, operating irrigation equipment, threshing, cleaning and grading of agricultural produce. The main sources of mobile power are human, draught animal, tractors, power tiller and self-propelled machines (combines, dozers, reapers, sprayers and etc.) where as the source of stationary power is oil engines and electric motors. For completion of timely farm operations, there is need to increase agricultural power acquirable from the present level of 1.75 kW per hectare to 4 kW per hectare by 2030. By 2020, in Uttar Pradesh, it is hope that about 70 per cent of unit farm operations i.e. tillage, sowing/planting, irrigation and threshing for all main crops will be fully mechanized and other unit operations for various crops will be mechanized up to 24–29 per cent. All 75-districts of UP may be stratified into 9-agro climatic zones strata, each zone consisting of many districts. The Uttar Pradesh is covered by into 9-agro climatic zones, 1. Bhabar and Tarai Zone 2. Western Plain Zone 3. Mid Western Plain Zone 4. South Western Semi-Arid Zone 5. Central Zone 6. Bundelkhand Zone 7. North Eastern Plain Zone 8. Eastern Plain Zone 9. Vindhyan Zone. Finally primary data was collected from all 9-agro-climatic zones for agricultural mechanization status i.e. 600 farmers and 40 farmers in each selected district in each agro-climatic zone as per the prepared proforma. In this present study, quantification of farm power availability was determined in all 9-agro climatic zones of Uttar Pradesh. The average value of farm power in 2018-19 Central Zone, Eastern Plain Zone, South Western Semi-Arid Zone, Bundelkhand Zone, Bhabhar and Tarai Zone, Mid-Western Plain Zone, North Eastern Plain Zone, Vindhyan Zone, and Western Plain Zone were 2.18, 2.93, 3.41, 1.61, 3.70, 3.47, 2.53, 2.37 and 5.38 respectively and was found 3.06 kW/ha in Uttar Pradesh which was 34.6% higher than country farm power availability. The farm power was highest in Western Plain Zone and was lowest in Bundelkhand Zone. The highest and lowest value of farm power were 5.36 kW/ha and 1.61 kW/ha respectively.

Keywords: Farm Power Availability, Agro-Climatic Zones, Uttar Pradesh, Mobile Power

QUANTIFY THE MECHANIZATION INDEX OF ALL 9-AGRO-CLIMATIC ZONES OF UTTAR PRADESH

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In Uttar Pradesh, during the year 2019, the farm power availability was 3.06 kilowatt per hectare. Although, the state should take more and more power farming in well-timed and precisely to obtain agricultural work at minimum amount and obtaining highest use work efficiencies in pricey inputs and also to conserve available resources because it is highly populated. In Uttar Pradesh, the cropping intensity was about 153 percent as per 2011 census. For completion of timely farm operations, there is need to increase agricultural power acquirable from the present level of 3.06 kW per hectare to 4 kW per hectare by 2030. The marginal, small and medium range of farmers can also take the benefit of farm mechanization for the high capacity equipment in most of the agricultural operations in which custom hiring is required. It is very much important to identify the variables, which are having highly significance towards the mechanization, once the quantification of mechanization is done. But, the three main levels i.e. human power, animal power and mechanical power technologies within each level of mechanization technology need consideration with varying degrees of structure, on the basis of accuracy, costs, effectiveness and capacity to do work. This would help in monitoring the mechanization status in the specific region in combination along with other agronomic mechanization indicators. By 2020 in Uttar Pradesh, it is hope that about 70 per cent of unit farm operations i.e. tillage, sowing/planting, irrigation and threshing for all main crops will be fully mechanized and other unit operations for various crops will be mechanized up to 24–29 per cent. Finally primary data on agricultural mechanization status was collected from all 9-agro-climatic zones i.e. 600 farmers and 40 farmers in each selected district in each agro-climatic zone as per the prepared proforma. In this present study, quantification of mechanization was done in all 9-agro climatic zones of Uttar Pradesh. The mechanization index is defined as the mechanical power to overall power i.e. power from human, animal and machine. The average values of mechanization index in all 9-agroclimatic zones were i.e. Central Zone, Eastern Plain Zone, South Western Semi-Arid Zone, Bundelkhand Zone, Bhabhar and Tarai Zone, Mid-Western Plain Zone, North Eastern Plain Zone, Vindhyan Zone, Western Plain Zone, 0.9464, 0.9535, 0.9541, 0.9201, 0.9587, 0.9547, 0.9502, 0.9481 and 0.9644 respectively and average values of mechanization index of Uttar Pradesh was 0.9501.

Keywords: Mechanization Index, Agro-Climatic Zones, Uttar Pradesh, Farm Mechanization

CROP RESIDUE MANAGEMENT FOR SUSTAINING HEALTH OF BLACK SOILS OF CENTRAL INDIA UNDER CONSERVATION AGRICULTURE BASED MAIZE-CHICKPEA CROPPING SYSTEM

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Soil health is an indispensable factor for current and future food security. However, degradation of black soils due to intensive farming practices is a silent disaster that leads to gradual reduction in quality, fertility and productive capacity of soil. Crop residues are valuable natural resources, which improve physical, chemical and biological properties of soil after being retained on soil surface

under conservation agriculture (CA). Hence, a study was carried out in an ongoing long-term experiment under CA at the research farm of ICAR–Indian Institute of Soil Science, Bhopal during Rabi season of 2018-19 to evaluate the impact of zero tillage (ZT) with residue retention on quality parameters of black soils under maize (*Zea mays* L.) chickpea (*Cicer arietinum* L.) cropping system in Vertisols of central India. The experiment was laid out in randomized complete block design with six replications and four treatments comprising different residue retention levels viz. conventional tillage (CT) without residue retention; ZT with 30% residue retention; ZT with 60% residue retention and ZT with 90% residue retention. The results showed that residue retention under CA significantly improved the physical properties of soil viz. bulk density and porosity at 0-5 and 5-10 cm depth. The bulk density was lower in upper soil surface (0-5 cm) as compared to the lower depth (5-10 cm). The highest soil organic carbon (1.01%) and soil available N, P and K were recorded with 90% residue which was followed by 60% (0.88%) and 30% (0.73%) residue retention level. Different pools of soil carbon, organic matter, soil moisture, soil porosity, available nutrients and fungal and actinomycetes count were significantly enhanced due to retention of 90% residue over 60%, 30% and without residue retention. Thus, retaining crop residue under CA improves soil structure, organic matter and microbial population which consequently lead to sustainable soil health.

Keywords: Black soil, conservation agriculture, maize-chickpea cropping system, residue retention, soil properties

IMPACT OF NITROGENOUS FERTILIZER AND INSECTICIDES ON INCIDENCE OF LEAFHOPPER, *Amrascabiguttulabiguttula* (Ishida) IN SUMMER OKRA

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Impact of nitrogenous fertilizer and insecticides on incidence of leafhopper, *Amrascabiguttulabiguttula* in okra was carried out at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand during summer, 2015. Results of pooled over 3 sprays during summer, 2015 revealed that flonicamid recorded the lowest (0.87 leafhoppers/leaf) leafhopper population and found significantly superior than rest of the insecticides. Dinotefuran (1.67) and thiamethoxam (1.87) were at par with each other. Dimethoate (2.62) was found least effective. Minimum population of leafhopper (2.02 leafhoppers/leaf) was observed in N0 (no application of nitrogen) and it was at par with N1 (2.13). Treatment N2 (2.36) and N3 (2.36) were at par which harbour higher population of leafhopper. The interaction between different doses of nitrogenous fertilizer and insecticides was found non-significant. It indicated that there was no any significant impact of nitrogenous fertilizers on efficacy of insecticides on leafhopper in okra.

Key words: Flonicamid, Thiamethoxam, Dinotefuran, Dimethoate and Okra

EFFECTS OF COMBINING ABILITY AND HETEROSIS IN DIALLEL CROSSES OF MAIZE (*Zea mays* L.) FOR YIELD AND YIELD CONTRIBUTING CHARACTERS

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A field research was carried out with 28 F₁s produced from eight white maize inbred, CML154 (P₁), VL109196 (P₂), CML491 (P₃), VL05590 (P₄), CML502 (P₅), CLRCWQ10 (P₆), CLRCWQ26 (P₇) and CML511 (P₈) following 8×8 half diallel fashion to evaluate their performance through estimating the combining ability effects and heterosis. The experiment was conducted with three replications at Experimental field of Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. Assessment of combining ability and heterosis was done for eight characters i.e. days to pollen shedding, days to silking, plant height, ear height, ear length, number of grains/ear, 1000 grain weight and yield. Considering overall performance of GCA effects suggested that parent P₆ was the best general combiner for both high yield and earliness while parent P₂ and P₈ for dwarfness. Two hybrids namely P₃×P₅ and P₆×P₈ exhibited significant positive SCA effects and significant positive heterosis for grain yield. Therefore, these two hybrids were suggested for further trial to verify their performances.

Keywords: white maize, Diallel, SCA, GCA, Yield

COMMON METABOLIC DISEASES OF UTTARAKHAND GOATS AND THEIR PREVALENCE

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Goats are assumed as an important animal from ancient period. In the present context as there is increasing prudent interest towards goat husbandry practices globally, profound animal husbandry practices are attaining importance under the target of obtaining quality products along with good animal health and welfare. The present research trial was conducted during the period of 1st January 2019 to 31st December 2019. During this period we had registered total 957 goats at various villages of districts Dehradun, Nainital and Uddham Singh Nagar of Uttarakhand beside this we had also included the concerned cases from Government Veterinary Hospital Outpatient departments (OPDs) of the above said districts in Uttarakhand. Various studies have been performed regarding the prevalence of the metabolic diseases among large ruminants in India; however, such prevalence studies about small ruminants are meager in our country. So due to the availability of meager findings concerning to prevalence of the metabolic diseases in small ruminants, the present study was conducted. Among small ruminants i.e. goat's hypocalcaemia, pregnancy toxemia and hypomagnesaemia are the common metabolic disorders which normally precipitated during metabolic anxiety phase. The findings of present study revealed that among preparturient hilly region goats 6.72%, 5.88% and 4.20% goats were positive for hypoglycemia, hypocalcaemia and hypomagnesaemia, respectively. However for hilly region post-parturient goats 5.45%, 5.88% and 3.63% goats were positive for hypoglycemia, hypocalcaemia and hypomagnesaemia, respectively. Meanwhile, among preparturient goats of Tarai region 6.49%, 2.27% and 1.94% goats were found positive for hypoglycemia, hypocalcaemia and hypomagnesaemia, respectively and for post parturient goats of Tarai region 7.94%, 3.01% and 2.73% goats were found positive for hypoglycemia, hypocalcaemia and hypomagnesaemia, respectively.

Key words: Prevalence, Hypocalcaemia, Pregnancy toxemia and Hypomagnesaemia

EFFECT OF LAND USE SYSTEMS ON SOIL PROPERTIES IN WESTERN TERAI OF NEPAL

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Rice-wheat-fallow, rice-wheat-rice, rice/lentil-fallow, rice-vegetable-vegetable, native grasslands, and agroforestry are the major land use system in the Kanchanpur district, lies western terai of Nepal. Deforestation, overgrazing, poor soil management, and severe erosion are the major problems in these land use system. The study was conducted in three municipality of Kanchanpur district, namely Bhimdatta municipality, Krishnapur municipality and Shuklaphanta municipality to evaluate the effect of land use systems on selected physical and chemical properties. From each sample site, composite soil samples of two depth (0-15 cm, and 15-30 cm) were collected from six treatments in five replications. The collected samples were analyzed for different physical and chemical properties in soil and fertilizer testing laboratory at Sundarpur, Kanchanpur. The data obtained were analyzed using R-studio. Soil properties were significantly affected by land use systems. Soil carbon content and total nitrogen were significantly higher in native grasslands system (27.54 ton ha⁻¹ and 2.38 ton ha⁻¹) and lowest in rice-wheat-fallow system (15.93 ton ha⁻¹ and 1.37 ton ha⁻¹). While the available phosphorus content was significantly higher in rice-vegetable-vegetable system (123.81 kg ha⁻¹) and lowest in native grassland system (14.26 kg ha⁻¹). The available potassium content (218.68 kg ha⁻¹) was higher in native grassland system and lower (70.78 kg ha⁻¹) in rice/lentil-fallow land use system. Bulk density was also statistically different as (1.29 g cm⁻³ in rice-wheat-rice and 1.22 g cm⁻³ in native grasslands). Since land use systems and management practices significantly affect soil physical and chemical properties, an appropriate and sustainable land use management option including conservation agriculture is necessary for fertile and healthy soil.

Keywords: Land use system, Physical properties, Conservational Tillage, Grassland

SCOPE OF INTENSIVE INTEGRATED FARMING SYSTEM FOR SMALL AND MARGINAL FARMERS IN NORTH EAST INDIA FOR DOUBLING INCOME UNDER CLIMATE RESILIENT AGRICULTURE

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Sustainable livelihood can be achieved through intensive integrated farming system because in North East India farmers generally belong to small and marginal category based on their land holding capacity. In NEH region of India, more than 80 % of the total cultivators are small and marginal farmers as well as only 3.4 % of the total area is suitable for cultivation but 4 agro-ecological zones are covered exclusively by NEH region. The farming systems of the NEH region of India are complex due to the prevalence of shifting/jhum cultivation, which leads to land degradation and food insecurity, the deficit in food grain production for the NEH region is projected to be 18-20% during 2030 to 2050. However, in intensive integrated farming system a surplus is

projected because of reasonable land and agro-climatic conditions in the North East India. Thus, there is an excellent capability of intensive integrated farming system in the NEH region to improve employment and hence double the income of farmers. The location specific intensive integrated farming system models like crops-fish-dairy-Multipurpose trees, crops-fishery-livestock, broiler chicken-crop-fish-duck-horticulture crops, rice-rapeseed/mustard + honey bee keeping, rice-fish-pig-kitchen garden, rice-fish-pig-horticultural crops, rice-fish-duck-mushroom cultivation- MPTs, rice-vegetables-fish-duck, rice-fish-poultry-livestock etc., activities for upgrading productivity, employment and income of the small and marginal farmers. The farmers can acquire double income through fingerling production, as well as vegetable seed production because today agricultural inputs like high yielding vegetable seed and fingerlings demand is high and farmers can accomplish it within 2 to 3 months. The double income of the farmers are expected in pond based intensive integrated farming systems and it can get minimum net profit of Rs. 2 to 3 lakh/annum from 0.48 ha land, if farmers can well manage the farming system. Thus, to double farmers income, reduce climate change induced risks, upgrade food, nutritional and environmental security, intensive integrated farming system is the most appropriate methodology for the NEH of India.

Keywords: Farming system, food security, nutritional security, improved livelihood, cropping intensity

IMPACT OF SILICON SOLUBILIZING BACTERIA WITH ORGANIC RESIDUES ON GROWTH OF KARANJ(*Pongamia pinnata*)

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A study on "Impact of silicon solubilizing bacteria with organic sources growth of Karanj(*Pongamia pinnata*)" was undertaken during 2017-18 at Agroforestry Research Farm, College of Agriculture, Nagpur. The experiment was framed in randomized block design with nine treatments which were replicated for four times. The nine treatments designed were T₁ - Absolute control, T₂ - 5 ml SSB lit⁻¹ tree⁻¹, T₃ - 5 ml SSB + 200 g N tree⁻¹, T₄ - 5 ml SSB + 200 g N from FYM tree⁻¹, T₅ - 5 ml SSB + 200 g N from VC tree⁻¹, T₆ - 5 ml SSB + 200 g N from bamboo litter tree⁻¹, T₇ - 5 ml SSB + 200 g N from teak leaf litter tree⁻¹, T₈ - 5 ml SSB + 200 g N from CDS tree⁻¹, T₉ - 5 ml SSB + 200 g N from compost tree⁻¹. Initial plant canopy ranged from of 1.51 m to 2.18 m. Treatment T₃ with 5 ml SSB along with 200 g N tree⁻¹ recorded highest value of plant height (3.9 m) and the lowest value (3.03 m) recorded in treatment T₁ absolute control without any inputs. An increase of 27.54 per cent was recorded in treatment T₃ with application of 5 ml SSB along with 200 g N tree⁻¹. The highest value of final plant canopy of karanj plant was recorded in treatment T₉ (2.94m) with application of 5 ml SSB along with 200 g N from compost tree⁻¹ and the lowest was 1.8 m recorded in treatment T₇ with application of 5 ml SSB along with 200 g N from teak leaf litter. Over the all treatments, the highest percent increased in was found in treatment T₅ with the application 5 ml SSB along with 200 g N from VC was found 36.37 per cent. Treatment T₅ addition of 5 ml SSB along with 200 g N from FYM tree⁻¹ was recorded highest value of stem girth (5.77 cm). The lowest value recorded at treatment T₁ (1.48 cm) without any inputs. The more per cent increased in treatment T₄ with application of 5 ml SSB along with 200 g N from FYM tree⁻¹ was found 42.31 per cent which was highest among all treatments. The result revealed that, the addition of different organic sources improves plant growth in Karanj.

EFFECT OF SILICON SOLUBILIZING BACTERIA WITH ORGANIC RESIDUES ON MICROBIAL POPULATION IN SOIL UNDER *Pongamia pinnata*(KARANJ)

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The present investigation on "Effect of silicon solubilizing bacteria with organic residues on microbial population in soil under *Pongamia pinnata* (Karanj)" was carried out during 2017 – 2018. The experiment was laid in randomized block design with nine treatments consisting of various organic sources combined with silicon solubilizing bacteria which were replicated for four times, at Agroforestry Research Farm, College of Agriculture, Nagpur. The study revealed that, the effect of silicon solubilizing bacteria with different organic sources significantly and non- significantly affected the microbial population in soil under *Pongamia pinnata*(Karanj). The population of fungi and silicon solubilising bacteria ranged from $13.77 * 10^5$ to $19.87 * 10^5$ cfu g⁻¹ and $12.23 * 10^{12}$ to $19.31 * 10^{12}$ cfu g⁻¹ respectively. Whereas, the count of actinomycetes and bacteria ranged from $23.31 * 10^4$ cfu g⁻¹ soil to $27.43 * 10^4$ cfu g⁻¹ and $82.35 * 10^6$ cfu g⁻¹ soil to $87.51 * 10^6$ cfu g⁻¹ soil respectively. The significantly highest count of fungi was recorded in treatment T₇ with application of 5ml SSB along with 200 g N from teak leaf litter tree⁻¹ ($19.87 * 10^5$ cfu g⁻¹). Whereas, the significantly highest count of silicon solubilising bacteria was recorded in treatment T₅ with application 5 ml silicon solubilising bacteria along with 200 g N from vermicompost tree⁻¹ ($19.31 * 10^{12}$ cfu g⁻¹). The population of actinomycetes and bacteria was influenced non significantly by organic sources along with silicon solubilising bacteria. The highest count of actinomycetes ($27.43 * 10^4$ cfu g⁻¹) and bacteria ($87.51 * 10^6$ cfu g⁻¹) were recorded in treatment T₉ with application 5 ml SSB along with 200 g N from compost tree⁻¹. Thus, from above study it was found that, incorporation of teak leaf litter, vermicompost, compost along with 5 ml SSB increased microbial community.

INCLUSIVE RESEARCH ON CULTIVATION OF ORGANIC *FRAGARIA ANANASSA* BY USED OF PGBM & AOS

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Bio-manure enhance the soil fertility naturally and does not affect the soil like chemical fertilizer. In this study, the comparative effect of PGBM and AOS on the growth and yield of *Fragaria Ananassa* was studied. The seeds of *Fragaria ananassa* were treated with AOS and PGBM their result was recorded after intervals. It was observed that plants treated with AOS and PGBM showed exceptional results in the morphological parameters as compared to controlled plants. The results further showed that the plant enactment with respect to biomass components such as mean number of phenotypic characters were expressively influenced by used bio-manure. The total plant biomass was found to be higher with application of AOS and PGBM and control as compared to

combination of them. At the appropriate stages of growth, the following traits were investigated: number of fruits per plant, fruit length, fruit width, number of branches per pant, days to maturity, and final plant weight. Data collected were subjected to analysis of variance (ANOVA) and phenotypic analyses computed. Results show that there is a strong relationship between fruit length and fruit width with the juxtaposition of number of fruits per branch. Hence, selection programme based on these traits are most likely to bring about further improvement in the yield of *Fragaria ananassa* under treated conditions. AOS and PGBM has enhance level of growth than chemical treatments. So, it can be concluded that AOS and PGBM can be best substitute for chemical fertilizer, which has proven positive effects on various crops with environmental sustainability and human health.

Keywords: Bio-manure, ANOVA, PGBM and AOS.

MICROBIAL INACTIVATION IN MANGO (*Mangifera indica*L.) PULP USING OHMIC HEATING

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The agricultural produces from fruits and vegetables are mostly preserved by conventional processing, recently being the most cost effective means confirming microbial safety. Mangoes (*Mangifera indica*L.) are good source of nutrients, but huge qualitative loss found during the thermal processing. The aim of the study was focused on the inactivation of microbes during ohmic heating in different concentration of mango pulp (6, 10 and 14° C). Mango pulp inoculated with bacteria and yeast/mold were subjected to ohmic heating with voltage gradients of 10, 15 and 20 V/cm and temperature of 60, 70 and 80° C. When compared with conventional heating, less no of microbes found after ohmic heating with minimum treatment time. The number of bacteria and yeast/mold reduced by increasing the electric field as 20 V/cm found to be effective among three voltage gradients. While considered the raise in temperature bacteria and yeast/mold count was reduced at high temperature (80° C) and as the sugar concentration increased (14° brix) microbial number decreased. The bacterial load was found to be 80 cfu/ml which was minimum among all the ohmic treated mango pulp samples, where the treatment condition was at 20 V/cm and to achieve 80° C, the heating time was 340 sec for a 14° C pulp concentration. The yeast / mold count was found to be 7 cfu/ml at high pulp concentration (14° brix) with a pasteurization temperature of 80° C (heating time 340 sec) at 20 V/cm. The results recommended that the lethal effect on microorganisms due to ohmic heating was not only due to thermal effect, but also a non-thermal effect (electric current). Ohmic heating can be effectively used for the pasteurization of mango pulp, the conclusion made from the above results.

Keywords: Ohmic heating (OH), Conventional heating (CH), Microorganisms, Mango

PREPARATION OF BIO-FERTILIZER BY USING KITCHEN WASTE AND STUDY ITS APPLICATION ON CROPS

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Bio-fertilizer is low cost, renewable sources of plant nutrients which supplement chemical fertilizer. Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. In the present work we have prepared total three types of bio-fertilizers by using different waste materials. At first we have prepared bio-fertilizer by using kitchen waste. After preparation of bio-fertilizers, we used above bio-fertilizers in three different crops in field such as ladies finger crops, brinjal crops and ramteel crops and study the growth and production of crops after intervals of every five day. We have also comparative studied the better growth and production of crops after using of above prepared bio-fertilizers.

Keywords: herbal soap, guava leaves, neem leaves, antibacterial properties.

LACTIC ACID BACTERIA FOR THE MANAGEMENT OF ROOT-KNOT NEMATODES

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Lactic acid bacteria (LAB) have traditionally been used to ferment carbohydrate-rich foods. LAB are known to improve the nutritional value of foods and control human intestinal infections. They also have an antagonistic activity against pathogenic bacteria and fungi, which makes them ideal for developing biocontrol agents for use on plants. For these reasons, LAB are currently attracting much attention in the agricultural industry as alternatives to chemical pesticides, which are associated with problems such as antibiotic resistance and pesticide residue. Root-knot nematodes (RKNs) are among the most destructive plant-parasites worldwide, and RKN control has been attempted mainly using chemical nematicides. However, these chemical nematicides have negative effects on humans and the environment, thus necessitating the search for eco-friendly alternative RKN control methods. Here, we screened nematicidal lactic acid bacteria (LAB) isolated and evaluated their efficacy as biocontrol agents against RKNs. Total of 35 LAB strains were isolated from vegetables and fruits. Among these, 6 strains exhibited distinct nematicidal activity against *Meloidogineenterolobii*J2 with the induction of more than 90% mortality at a concentration of 2.5%. Among these strains, the culture filtrate of LAB strain 12 showed the strongest nematicidal activity against *M. enterolobii* J2 with 98.03% mortality within 3 days of exposure, at a 1%.concentration.

Keywords:Lactic acid bacteria, *Meloidogineenterolobii*Guava

MANAGEMENT OF BRINJAL PESTS USING NATIVE ISOLATES OF ENTOMOPATHOGENIC NEMATODE FROM THENI

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Survey for entomopathogenic nematodes was conducted in and around 50 places of Theni district. Out of the fifty samples only four samples yield entomopathogenic nematode. All the four samples are found to be *Steinernema* sp. and no *Heterorhabditis* positive sample was obtained. Morphometric data revealed 4ME2 isolate as *Steinernemasiamkayai* and 6Ko1 and other isolates as *Steinernemacarpocapsae*. Laboratory screening against *Leucinodesorbonalis* revealed *S. siamkayai* (4ME2) is more effective when compared to *S. carpocapsae* (6Ko1) causing 100 per cent mortality within in 72h after treatment. It also causes mortality of *Mylocerusviridanus* and *H. vigintioito punctate* grubs, pupae and adults and grubs within 48h after inoculation. Field trials revealed that *S. siamkayai* (4ME2) @ 2.0x10⁶ IJ/ml is highly effective in managing the pest within 3 days of application.

Keywords: *Steinernemasiamkayai*, *Leucinodesorbonalis*, Brinjal

ECOFRIENDLY MANAGEMENT OF MORINGA BUDWORM, *Noordamoringae* USING NATIVE ENTOMOPATHOGENIC NEMATODE, *Steinernemacarpocapsae*

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Moringa (*Moringa oleifera* Lam.) is an invaluable vegetable crop belonging to the family Moringaceae and this crop is being faced by many pest and disease problems throughout its crop stage. Moringa budworm, *Noordamoringae* (Wlk.) is the major pest which accounts maximum loss in yield production. At present this pest became resistant to many insecticides. Effective control includes the application of insecticides and it increases the production cost and environmental pollution. So, it is the time to use native entomopathogenic nematode *Steinernemacarpocapsae* (MK977607) from brinjal rhizosphere in Theni District for the management of the pest. Experiments were performed in the laboratory and in the field to assess the efficacy entomopathogenic nematodes, *S. carpocapsae* in decreasing the numbers of *Noordamoringae*. Laboratory experiments showed 92±1.2 mortality within 24h after application @ 1juvelines/larvae.

Keywords: *Steinernemacarpocapsae*, *Noordamoringae*, Moringa

EFFECT OF BIOCHAR COMPOST ON GROWTH AND YIELD ATTRIBUTES OF RICE UNDER CLAY LOAM SOIL CONDITION

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A field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, during *rabi* season 2016-17 to study the effect of biochar compost (BC) in nitrogen management of rice. The combinations of biochar compost, inorganic fertilizer and effective microorganism (EM) solution were tried with ten treatments in Randomized Block Design and replicated thrice. 25 %N by BC with 75 % N through inorganic fertilizer likewise 50 and 75 % N by BC with remaining N through inorganic fertilizer as well as 100 % N by biochar with and without application of EM along with N control. Basal application of N through Biochar, P & one-third of K was given to all the treatments. The Remaining 2/3rd dose of K were applied at active tillering and panicle initiation stages respectively. The results of the field experiment revealed that the growth parameters like plant height, leaf area index, and number of tillers, productive tillers, dry matter production and root biomass and yield parameters like panicle length, number of spikelets per panicle, number of filled grains per panicle, high density grains per panicle test and highest grain and straw yields were prominently seen highest by 25 percent N by biochar compost and 75 percent N through inorganic fertilizer with the application of EM. A Combination of BC+inorganicfertilizer+ EM had increased the N, P and K uptake at all the stages of crop growth. The higher organic carbon content was observed in 100 % N by biochar compost with the application of EM at all the stages of crop growth. The unerring effect of these 25 % biochar combinations was enhances the higher grain yield in this investigation of nutrient management of rice. An individual effect of EM had not been perceptible in all the growth and yield parameters.

Keywords: Biochar compost, EM, growth and yield attributes and nitrogen.

REPRODUCTIVE BIOLOGY OF *Valerianawallichii* DC., A THREATENED MEDICINAL PLANT OF HIMALAYAN REGION

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Valerianawallichii DC. (Valerianaceae), is a medicinal plant of Himalayan region with separate individuals bearing female flowers, hermaphrodite flowers and both female and hermaphrodite flowers. Plant reproduces sexually and multiply asexually by means of underground rhizome which produces aerial shoots. The rhizomes are collected for medicinal value leaves no chance for the survival of the species in nature. Keeping in view the status of the species in nature, a study on its reproductive biology was planned. Incessant exploitation from nature for meeting the demands of pharmaceutical industry put unbearable pressure on its natural habitat. It has been therefore, declared as a critically endangered species. The aim of this study was to design strategies for its conservation, both *in-situ* and *ex-situ* on the basis of information generated so. Since species exhibit varied type of sex expression, its reproductive biology is very interesting. Data on different aspects

including Ecology, phenology, pollination biology, breeding system, population structure was collected. Populations consist of both flowering and non-flowering individuals. There is significant difference in the size of female and hermaphrodite flowers. The observations revealed that the species displays a mixed mating system due to cross as well as self-compatibility and entomophilous pollination. Reproductive output was more in *ex-situ* plants pointing towards pollen/pollinator imitation in *in-situ* populations of the species. The observations made so are more than enough to suggest that a comprehensive conservation programme involving *in situ* as well as *ex situ* strategies will be effective for conservation and long term survival of the species. The details will be discussed during the presentation.

Keywords: *Valerianawallichii*, conservation, *in situ*, *ex situ*

ANTITUMOR ACTIVITY, IMMUNOMODULATORY AND THERAPEUTIC POTENTIAL OF *Piper longum* L. FOR DISEASE REGULATION – A REVIEW

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In ancient time, *Piper Longum* was traditionally used as a potential drug for the treatment and control of various diseases because of its antitumor activity, immunomodulatory, neuroprotective, cardioprotective, respiratory protective and therapeutic potential in many parts of the world. Nowadays in the world of advance medicine where increased resistance of bacteria, virus or other microbes to antibiotic, adverse effects associated with use of antibiotics and there coastally are of great concern, there is a need for development of prevention and treatment options that are natural, safe, effective and economical beneficial. The study for alternative products continues and natural phytochemicals isolated from plants used as traditional medicines are considered as good alternatives. In this perspective, in the present review, we reviewed the medicinal effects of *P. longum* on different systems of the body and also discussed its phytochemicals components. This review will open the new avenue for the researchers and provide insights to look upon the unseen therapeutic potential of this herb. Plant based therapy are marked due to its low cost and easy availability. Furthermore, the plant appears to be nontoxic, in most of the studies. Therefore, in summary we conclude that this plant is safe and effective for use in various diseases. These outcomes suggest that *Piper longum* extracts or its phytochemical element can be used as dietary supplement for the prevention of many diseases. Therefore, the purpose of this review is to present some recent examples from the literature of studies that have served to validate the traditional use of *Piper longum* with specific biological activity.

Keywords: *Piper Longum*, antitumor, immunomodulatory, neuroprotective and cardioprotective.

EFFECT OF DIFFERENT ORGANIC MANURES AND GIBBERELIC ACID CONCENTRATIONS ON GROWTH AND YIELD OF STRAWBERRY (*Fragaria X ananassa* Duch.)

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The experiment was conducted to find out the best combination effect of organic manure and growth regulator on growth and yield of two varieties of strawberry namely 'Sweet Charley' and 'Winter Dawn'. There were 6 (six) treatment combinations with three different organic manures namely, Vermicompost (3.0 t/ha), Mustard oil cake (1.0 t/ha) and Neem cake (1.0 t/ha) combined with two concentrations of gibberellic acid (GA₃) viz. 75 ppm and 100 ppm along with a control. Organic manures were applied as basal, whereas foliar application of GA₃ was done at 40 days and 60 days after planting. Experimental results showed that along with vermicompost higher doses of GA₃ (100 ppm) exhibited more vegetative growth whereas 75 ppm GA₃ resulted higher fruit set and yield in both the varieties. Maximum plant height (24.7cm and 21.4cm) and number of leaves per plant (46.0 and 68.7) were found under vermicompost (3.0 t/ha) combined with 100 ppm GA₃ (T-2) whereas maximum fruit diameter (3.3cm and 3.4cm), fruit length (4.6cm and 4.8cm), fruit weight (18.2g and 17.9g), number of fruits per plant (24.6 and 32.0), yield per plant (447.8g and 572.1g) and yield per hectare (18.80t and 24.03t) were recorded under vermicompost (3.0 t/ha) combined with 75 ppm GA₃ (T-1) in both Sweet charley and Winter Dawn varieties, respectively. Again Winter Dawn variety produced 28.0% higher yield as compared to Sweet Charley under the best treatment (T-1). Therefore, cultivation of strawberry with application of 75 ppm GA₃ along with 3.0 t Vermicompost per hectare can bring ample scope for increasing crop yield to fetch more profit for the farmers.

Keywords: Strawberry, Organic manure, Gibberellic acid, Foliar application, Yield

ESTIMATION OF GROUND WATER RECHARGE BY WATER BUDGET METHOD TO MAINTAIN DEPLETING WATER TABLE

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Estimation of groundwater is an effective tool for proper planned and optimal utilization of water resources in the context of future requirement. Our main purpose for the estimation of groundwater in soradih village of Nalanda district, Bihar is to make a complete assessment of ground water resources and produce it that can be incorporated for future requirement. The study was undertaken based on the recommendation of groundwater estimation committee, 1997 (GEC-97). Methodology used the estimation of annual groundwater recharge from rainfall and other sources including irrigation, water bodies and artificial recharge, determination of present status of groundwater, utilization and categorization of assessment units based on the level of groundwater utilization and long- term water level trend. Water level fluctuation techniques and empirical norms were used for

recharge estimation. The data collected for investigation were water table fluctuation, rainfall, cropping pattern, number of groundwater structures, geographical area, groundwater draft, ponds area etc. The study revealed that total annual groundwater recharge is 52.35 ha-m. The ground water draft for all uses is 43.80 ha-m. The net annual ground water available for future irrigation development is 8.55 ha-m. According to definitions used by CGWB Nalanda district falls in safe category. The study recommended that there is a good scope for future groundwater development and keeping in view of rapid increase in groundwater draft, roof top rainwater harvesting needs to be taken up to recharge the aquifer in Nalanda district particularly in urban areas.

Keywords: Ground water, Water budget, Recharge and Water table fluctuation.

**SCREENING FOR OKRA YELLOW VEIN MOSAIC DISEASE RESISTANCE IN WILD
OKRA (*Abelmoschus moschatus*ssp.*moschatus*) GERMPLASM IN INDIA**

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Okra yellow vein mosaic disease (OYVMD) is a major viral disease of okra crops. *Okra yellow vein mosaic virus* (OYVMV) is responsible for direct yield loss of the okra produce in terms of both quantity and quality of capsules (fruits). DNA-A of coat protein, intergenic region and partial rep protein sequences have been determined using OY2395F/OY680R specific primer amplified at 1.2 Kb showed the presence of OYVMV. Two year field screening of wild okra accessions (*Abelmoschus moschatus*ssp.*moschatus*) carried out during kharif 2017 and 2019 against OYVMD in agro-ecological conditions of New Delhi. Experiments were conducted in ICAR-NBPGR Experimental Farm, Pusa. Among the seventy six (76) wild okra accession used for two years of field screening in New Delhi, ten accessions viz., EC 360586, EC 360794, EC 360830, EC 360900, EC 359730, EC 359836, EC 359870, EC 360351, EC 361171 and EC 361111 exhibited highly resistant (HR) response in kharif 2017. While in 2019, out of these 10 promising accessions four accessions viz., EC 360794, EC 360586, EC 360830 and EC 361171 showed HR response. Rest of the lines showed either moderately resistant (MR) or Susceptible (S) response. Average percent disease incidence (PDI) value was 19.51 and 4.46 to 64.06 was range value for the first year of field screening. Whereas the recorded average PDI was 21.77 with the range value of 4.36 to 67.33 in the second year of field screening. For both the years of field screening, out of 76 accessions four accessions viz., EC 360794, EC 360586, EC 360830 and EC 361171 were found promising and exhibited HR response. Promising lines could be utilized in breeding programmes for development of varieties resistance to OYVMV.

Key words:*Abelmoschusmoschatus*, OYVMV, OYVMD, Field screening, DNA-A

**SCREENING FOR OKRA ENATION LEAF CURL DISEASE RESISTANCE IN WILD
OKRA (*ABELMOSCHUS MOSCHATUS* SSP *MOSCHATUS*) GERMPLASM IN INDIA**

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Okra enation leaf curl disease (OELCuD) is a recently emerged whitefly transmitted viral disease of okra which deteriorate vegetable quality with declined yield. *Okra enation leaf curl virus* (OELCuV) is a main disease causative agent. Betasatellite (DNA-β) molecule of OELCuV have been amplified at 1.3 Kb. Two year field screening was carried out in wild okra (*Abelmoschus moschatus*) accessions. Experiment were conducted during kharif 2017 and 2019 in ICAR-NBPGR, Experimental Farm, Pusa, New Delhi. Out of 76 wild okra (*Abelmoschus moschatus*) accessions used for two years of field screening, 10 wild okra accessions viz., EC 360586, EC 360794, EC 360830, EC 360900, EC 359730, EC 359836, EC 359870, EC 360351, EC 361111 and EC 361171 showed resistance (R) response in first year (kharif 2017) of field screening. Whereas, in second year (kharif 2019) among these 10 promising accessions four accessions viz., EC 360794, EC 360586, EC 360830 and EC 361171 exhibited resistance (R) response while six lines have given moderately resistance (MR) response. Average percent disease index (PDI) 14.15 and range value was 3.70 to 52.86 for the first year (kharif 2017) of field screening, while the average PDI was 18.04 with the range value of 4.53 to 56.40 in the second year (kharif 2019) of field screening. Since, OELCuD is transmitted by whitefly vector thus, apart from PDI value, whitefly population was also monitored for both years of field screening. In the first year of field screening average whitefly per leaf value was 0.522 whereas, 0.146 to 0.916 was range value for whitefly vectors per leaf. In the second year of field screening average whitefly per leaf value was 0.457 whereas, 0.110 to 0.880 was range value for whitefly vectors per leaf. Four accessions viz., EC 360794, EC 360586, EC 360830 and EC 361171 exhibited resistance response in both the years of field screening will serve as resistance source in breeding programmes to develop varieties resistant to OELCuV.

Keywords: *Abelmoschus moschatus*, OELCuV, Whitefly, OELCuD, DNA-β, Field screening

DIFFERENTIAL PHYSIOLOGICAL RESPONSES OF SORGHUM GENOTYPES TO SALINITY STRESS

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Salinity stress adversely affected plants growth and productivity due to ion toxicity and decreased absorption of mineral. Summer sorghum crop is mainly cultivated for forage and its faces serious threats due to low water supply and increased salt concentration in the soils resulting into reduced crop cover and diminished greenness. Hence, present investigations were carried out to study the differential physiological response of eight sorghum genotypes to salinity stress (salt tolerance). The experiment was conducted in the screen house and the earthen pots (15" Inches) filled with 10 kg of pre-washed yellow dune sand. Four salinity levels (0, 6, 8 and 10 dS m⁻¹) were maintained by saturating the pots with saline irrigations. Sampling was done at 50 % flowering and physiological

maturity. The deleterious effects were pronounced with 10 dS m⁻¹ of salinity treatment as only two genotypes survived out of eight *i.e.* SPH 1891 and CSV 32F and none of the entry showed seed setting. Among genotypes, significantly highest number of days to 50% flowering was taken by CSV 32F (107.42). Maximum number of days to 50% at 8 dS m⁻¹ of salinity level was 103.56 days which was at par with 6 dS m⁻¹ with maximum fresh and dry weight (50.32 and 12.44 g/plant) was recorded in CSH 13 significantly. Highest leaf area (1297.59 cm² plant⁻¹) was also recorded in CSH 13 at 8 dS m⁻¹. At physiological maturity, significantly highest fresh and dry weight (56.93 and 13.30 g/plant) was recorded in CSH 13 among all the genotypes at 8 dS m⁻¹. Only two genotypes (CSV 322F and CSV 30F) showed seed setting at 6 and 8 dS m⁻¹, however all the entries survived up to 8 dS m⁻¹.

Keywords: Sorghum, Salinity, Physiological parameters

EFFECT OF RICE ESTABLISHMENT METHODS AND NUTRIENT MANAGEMENT PRACTICES ON SUBSEQUENT WHEAT CROP GROWN UNDER DIFFERENT ESTABLISHMENT METHODS AND NUTRIENT MANAGEMENT PRACTICES AT RAMPUR, CHITWAN, NEPAL

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A field experiment was conducted to evaluate the effect of land management practices and residual effect of nutrient management practices of rice on the performance of subsequent wheat crop in the rice-wheat cropping system in Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal during June 2018-March 2019. The experiment was executed in a split-plot, included two establishment methods viz. (i) conventional tilled dry direct-seeded rice followed by (fb) zero tillage wheat (CT-DDSR fb ZT) (ii) puddled transplanted rice followed by conventional tillage wheat (Pu-TPR fb CT) as main plot treatments, and four nutrient management practices: (i) 100% recommended dose (100% RDF; 150:45:45 and 80:60:40 kg N, P₂O₅, and K₂O ha⁻¹ respectively for rice and wheat), (ii) Residue retention @ 5 t ha⁻¹ of wheat on rice fb residue of rice on wheat + 75% RDF of each crop (RR +75%RDF), (iii) Nutrient expert (NE) dose (140:56:53; 140:60:45 kg N, P₂O₅, and K₂O ha⁻¹ for rice and wheat respectively), (iv) Brown/green manuring of *Sesbania* in ricefb rice residue @ 3.5 t ha⁻¹ in wheat +75% RDF of each crop (BM/GM fb R+75% RDF) as subplot treatments with three replications. The variety of wheat 'Bijay' was sown @120 kg ha⁻¹ with spacing 20 cm × continuous. The data on phenology, yield, yield attributes, and economics were recorded and analyzed by R studio. The study revealed that the days to heading were not affected by both factors of the experiments. None of the yield attributes and yield of wheat were significantly influenced by the rice establishment methods. Significantly more effective tillers (281.94 m⁻²) and grains per spike (44.48) and higher straw yield (5.95 t ha⁻¹) were recorded under NE dose. The grain yield of wheat was 21% and 16% more under NE dose and BM/GM fb R+75% RDF respectively compared to 100% RDF. CT-DDSR fb ZT wheat had slightly less net returns (NRs. 4523 ha⁻¹) than Pu-TPR fb CT-wheat. NE dose was the most profitable. Hence, rice establishment methods were indifferent but NE dose was the best nutrient management practice for better production and profitability for the wheat in the rice-wheat system.

Keywords: Nutrient Expert, residue, zero tillage wheat

DNA BARCODING OF INDIAN ORCHIDS

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DNA barcoding is an important tool for rapid and easy detection of species, even if a minute amount of DNA is available. Thus this can be used for identification and detection of orchids of their adulterants which are often available in fragmented form. This concept was proposed by Hebert et al.2003 based on their study on 200 closely aligned lepidopterans species using cytochrome C oxidase. Maturase k and Rubisco large subunit both from chloroplast genome and Internal transcribed spacer from nuclear genome have been suggested as barcode for plants. An in silico route is followed to gain a prior insight into the efficacy of above mentioned loci as DNA barcode. All the sequence were download in FASTA format and blast on NCBI, the hits obtained from the blast table which showed 100% similarity with the query sequence was noted down and checked. 100% match of the query sequence with the sequence of other species was taken as failure for identification.

Its objective is to identify the possible barcode sequence from among the suggested loci (matk, rbcL, Its) using in silico approach.

BIONANOTECHNOLOGY IN AGRICULTURE

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Bionanotechnology is multidisciplinary knowledge gained at the intersection of biology and nanotechnology. Indian agricultural growth has reduced from about 3.6% in 1985–1995 to less than 2% in 1995–2005. This is far below than the targeted 4% annual growth in agricultural sector for 2020. The major concern is food grain production. Nanotechnology has shown promising potential to promote sustainable agriculture. This technique could be applied in improving important crops by organizing and linking carbohydrates, lipids, proteins and nucleic acids to synthetic three dimensional DNA crystals. Nanotechnology is also applied to prevent waste in agriculture. Mass production of nanosilica through nanotechnology can alleviate the growing rice husk disposal concern. Nanosensors and nano-based smart delivery systems could help in the efficient use of agricultural natural resources like water, nutrients and chemicals through precision farming. Nanotechnology has the potential of precise delivery of agrochemicals for improving disease resistance, plant growth, and nutrient use. Nanoencapsulated products show the ability of more effective and site-specific use of pesticides, insecticides, and herbicides in an eco-friendly and greener way. Several nanomaterials are used as antimicrobial agents in food packing in which several nanoparticles such as silver nanomaterials are in great interest. In food industries, nanoparticles are leading in forming the food with high quality and good nutritive value. Thus, in agricultural sector, nanotechnology plays an important role in crop production, food processing and packaging, food security and water purification, environmental remediation, crop improvement, and plant protection. Just like biotechnology, issues of safety on health, biodiversity, and environment along with appropriate regulation are raised on nanotechnology. Future research directions have been identified to promote the research into sustainable development of nano-enabled agriculture.

Keywords: Bionanotechnology, Crop production, Food security, Environment

HETEROSIS BREEDING IN SUNFLOWER (*Helianthus annuus* L.) IN INDIA: PRESENT STATUS AND FUTURE PROSPECTS

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Sunflower (*Helianthus annuus* L.) is a highly cross pollinated crop and the main objective of sunflower breeding is to develop high yielding hybrid cultivars with stable and high yield through exploitation of heterosis. Hybrid sunflower became a reality with the discovery of cytoplasmic male sterility and effective male fertility restoration system during 1970. Hybrids were preferred by growers worldwide due to high seed yield and quality potential, homogeneity, resistance to biotic stresses, synchronous maturing and ease of cultural applications. The inclusion of sunflower under AICRP and testing of experimental hybrids started as early as 1975 and first ever indigenous hybrid BSH -1 (CMS-234A x RHA-274) from public sector was released for commercial cultivation in 1980. Since then the hybrid breeding program has been quite successful and 45 CMS based productive single cross hybrids were developed by both public (34) and private sectors (11) in India. Despite these successes, problems in the form of stagnating and unstable yields, genetic vulnerability and susceptibility to various diseases like powdery mildew (PM), downy mildew (DM), *Alternaria* leaf spot, sunflower necrosis disease (SND) and sunflower leaf curl virus (SuLCV) are limiting sunflower productivity in India. One of the major challenges would be to develop newer and superior hybrids for diverse situations in order to sustain the competitive ability of sunflower *vis-a-vis* other crops. At present, much of the plant breeding research in All India Coordinated Research Project (AICRP) is directed towards exploitation of heterosis utilizing few CMS and fertility restorer lines. There is an urgent need for new restorers and CMS lines with diverse cytoplasm having several desirable attributes like high seed yield, high oil content, early maturity coupled with resistance to biotic and abiotic stresses. Towards this direction, attempts are being made to augment exotic breeding lines and also develop superior maintainer (B) and restorer (R) lines through appropriate gene pools, population improvement, recombination breeding and pre-breeding.

Keywords: Achievements, bottlenecks, heterosis, single cross hybrids

HEALTH PROMOTING PHYTOCHEMICAL IN VEGETABLE CROPS

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Phytochemicals are the primary source of antioxidants and play an important role in combating the damaging effects of oxidative stress and other adverse cell responses that can lead to a wide variety of chronic and degenerative illnesses. These phytochemicals typically consists of a wide array of phenolic compounds, ascorbic acid, alpha-tocopherol and carotenoids, and have been shown to promote health and provide protection against a growing list of diseases including various cancers and cardiovascular and neurodegenerative diseases. Phenolics are a group of compounds with ≥ 1 aromatic rings possessing ≥ 1 hydroxyl groups. Phenolics are generally are classified as subgroups of phenolic acids, flavonoids, stilbenes, coumarins, and tannins. Phenolic acids can be divided into

2 major subgroups: hydroxybenzoic acid and hydroxycinnamic acid derivatives. Flavonoids are a major group of phenolic compounds that commonly have a generic structure consisting of 2 aromatic rings (A and B rings) connected by 3 carbons that are usually in an oxygenated heterocycle ring, or C ring. Fruits, vegetables, and other plant foods are rich sources of flavonoids, which have been linked to reducing the risk of major chronic diseases, such as heart disease, cancer, stroke, diabetes, Alzheimer's disease, cataracts, and age-related function decline. Carotenoids are classified into hydrocarbons (carotenes) and their oxygenated derivatives (xanthophylls), with a 40-carbon skeleton of isoprene units). It is estimated that >600 distinct carotenoids have been isolated and identified with yellow, orange, and red colors and are present widely in fruits, vegetables, whole grains, and other plants. In terms of health benefits, carotenoids have received considerable attention because of their unique physiological functions as provitamins and antioxidant effects, especially in scavenging singlet oxygen. Vitamin C is an essential nutrient and plays an important function in collagen synthesis to prevent scurvy, a vitamin C deficiency disease. Vitamin C is also an excellent antioxidant to scavenge free radicals and to prevent oxidative stress. As a conclusion, vegetables contain bioactive substances with a potential for reducing the physiological as well as oxidative stress-induced DNA damage and this could explain the suggested cancer preventive effects as well as their protective role on other major diseases.

Keyword: Phytochemical, vegetable crops, preventive effects

PREDATORY POTENTIAL OF WOLF SPIDER, *Lycosa pseudoannulata* AGAINST THE GREEN LEAFHOPPER, *Nephotettixvirescens* (HEMIPTERA: CICADELLIDAE) IN RICE

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Rice is one of the important cereal crops widely used staple food in the world. This crop faces uninterrupted pest problem throughout the crop stage. Green leafhopper, *Nephotettixvirescens* is one of the most important destructive pests of rice. Chemical management measures were not much effective against this pest and developed resistance to many insecticides. Exploiting the use of predators is one of the alternates to insecticides. Wolf spider, *Lycosa pseudoannulata* is a potential and abundant spider in rice ecosystem. The present study was conducted at AC & RI, Madurai, to evaluate the efficacy of *Lycosa pseudoannulata* against Green leafhopper under laboratory condition. The results revealed that both sexes of *Lycosa pseudoannulata* are highly effective against Green leafhopper. Female spider consumed a greater number of green leafhopper (64.57%) and male spider (52.71%) were recorded. These results showed that wolf spider could be a part of an integrated pest management package, which recognizes the constraints of farmers while address the requirement to control *Nephotettixvirescens*.

**BIOINTENSIVE MANAGEMENT OF CITRUS CANCKER AND YIELD ENHANCEMENT
IN ASSAM LEMON THROUGH MICROBIAL BIOFORMULATIONS**

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Citrus Canker caused by *Xanthomonas citri* pv. *citri* (Xcc) is one of the most destructive disease of citrus. The present study was aimed at managing the disease using three microbial bioformulations, viz., Biogreen-5 (Combination of *Pseudomonas fluorescens*, *Bacillus thuringiensis*, *Beauveria bassiana*, *Metarhiziumanisopliae* and *Trichoderma viride*), Bioveer (*Trichoderma viride*) and Biosona (*Beauveria bassiana*). These bioformulations were evaluated under field conditions for their efficacy in suppression of citrus canker incidence, leaf miner infestation and enhancement of crop yield. Biogreen-5 applied both as soil application and as foliar spray showed highest suppression of the canker incidence (35.55% to 20.96%); leaf miner (46.78% to 25.08%), and fruit yield enhancement (17.43 to 41.93%).

Keywords: Bioformulation, Citrus canker, Disease management, Leaf miner infestation, Yield enhancement

LEAF DERIVED CALLUSING FOR PLANT REGENERATION FROM *IN VITRO* AND *IN VIVO* SHOOT EXPLANTS OF STRAWBERRY (*Fragaria x ananassa* DUCH.)

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The present investigation was carried out to study the plant regeneration using leaf explants obtained from *in vitro* and *in vivo* produced shoots of strawberry cv. Chandler. Both explants formed callus and multiple shoots. Highest callus induction (86.66%) and shoot regeneration (63.33%) was obtained with the calli of *in vitro* leaf explants on MS medium supplemented with BAP and NAA. The time required for callus induction and regeneration by the leaf explants from shoots grown under *in vitro* was less as compared to shoots produced under *in vivo* conditions. The number of shoots and shoot length obtained from *in vivo* leaf explants were also lesser as compared to *in vitro* conditions. The *in vitro* leaf derived calli was transferred to root initiation media containing different concentration of IBA and NAA, supplemented with activated charcoal after 8 weeks. Highest root initiation (91.33 per cent) was recorded on MS media supplemented with 1.5 mg/L of IBA and 200 mg/L of activated charcoal. The newly regenerated plantlets were sterilized and hardened in field conditions. The study inferred that *in vitro* explants takes less time for callus induction and regeneration, along with production of more number of shoots with increased shoot length and more number of roots and higher root induction as compared to *in vivo*.

Keywords : strawberry, callus, *in vivo*, *in vitro*

SOIL AND WATER CONSERVATION IN RELATION TO CROP PRODUCTIVITY

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Soil quality and water availability are the major factors determining global food production, obtained from only 12% of the earth's land surface. Such natural resources are under immense pressure due to the ever-increasing population and changing climate. Soil erosion is a serious problem causing land degradation. Accelerated erosion severely affects crop productivity which is attributed to loss of rooting depth, degradation of soil structure, decrease in plant-available water reserves, reduction in organic matter, and nutrient imbalance. Pollution of nearby water bodies and wetlands and reduced cropland area is linked to erosion process. Water and wind are the major agencies which are responsible for soil erosion. Acidification, compaction, salinization and human activities like urbanization, overgrazing, poor management of arable soils and deforestation also trigger soil erosion. In India, water erosion resulted in an annual crop production loss of 13.4 Mt in cereal, oilseeds and pulses. The future of agriculture is at stake also due to continuous depletion of ground water. Moreover, climate change will increase water demand globally by about 40% of the water needed for irrigation. Erosion resulted in reservoirs siltation which ultimately influences the cycle of power generation, ecological imbalance, environmental pollution, drought and floods. Therefore, appraisal on soil and water conservation measures and its implication on food security are crucial. In view of this, the land use policy emphasizes on the integrated use of soil and water conservation measures including biological (agronomic/agroforestry) and mechanical measures (terracing, bunding, trenching, check dams, etc.) to reduce runoff, soil erosion and to improve moisture conservation, and overall crop productivity in a sustainable way. Rain water harvesting, runoff management, recharging the aquifers and optimum utilization of water are the principles of soil and water conservation. Hence, a holistic management approach of soil and water resources by linking social and economic development with protection of natural ecosystem is the need of the hour.

Keywords: Land degradation, water depletion, conservation, agricultural productivity

ROLE OF FOREST IN GLOBAL CLIMATE CHANGE

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Earth's environment has been undergoing changes because of increasing human population and its activities; the foremost vital changes being the rise in concentration of carbon dioxide and different inexperienced greenhouse gases within the layer. Varying temperature and precipitation pattern and increasing concentrations of atmospheric carbon dioxide are possible to drive vital modifications in natural and changed forests. As the forest are supposed carbon sinks have compete a vital role in global climate change negotiations and represent a central part within the theme to limit

atmospheric greenhouse emission concentrations launched by the Kyoto Protocol. Forest has a massive potential in mitigating global climate change through forest restoration. Trees and different vegetation fix carbon as a part of chemical process and soil too holds organic carbon from plants and animals. The number of soil carbon varies with land management practices, farming strategies, soil nutrition and temperature. The IPCC fifth assessment report (2014) clearly identifies the forest sector mutually of the key sectors liable for greenhouse emission emissions, whereas preserving and reducing forest biomass loss will give a comparatively low-cost choice for global climate change mitigation (Stern, 2007). The number of carbon a tree sequesters varies supported the expansion rate, age, and species of the actual tree. Hence, forest isn't simply a bridge to the future; it ought to be a crucial a part of any management strategy required to mitigate global climate change. In this, we have a tendency to discuss the potential role and cost-effectiveness of forest conservation, restoration and management (REDD+) in global climate change mitigation; the worth and (co-) advantages of forests.

Keywords: Climate change, Greenhouse Gas, Biomass, Mitigation, Carbon sequestration

COMPARATIVE GENOMICS OF *OPR3* AND *COI1* ACROSS BRASSICACEAE TO UNDERSTAND ORGANIZATION AND EVOLUTION, AND PUTATIVE ROLE IN STAMEN DEVELOPMENT

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Stamen development is a tightly regulated process involving interaction of transcription factors, miRNA, and hormones. Previous studies have shown Jasmonic acid (JA) playing an indispensable role during stamen maturation in *Arabidopsis thaliana*, model dicot from Brassicaceae. Identification and characterization of regulatory elements involved in stamen development and maturation will permit designing strategies to induce male sterility and restoration of fertility in crop plants such as *Brassica* for development of hybrid seeds. In *A.thaliana*, 12-Oxophytodienoate reductase 3 (*OPR3*) has been shown to be involved in jasmonic acid biosynthesis and Coronatine insensitive 1(*COI1*), a part of E3 ubiquitin ligase plays an important role in JA signaling. We performed *in-silico* analysis to identify homologues of *OPR3* and *COI1* from nine members of Brassicaceae. Promoter alignment revealed extensive sequence variation; PlantPAN and PlantCARE analysis revealed diverse set of transcription factor binding sites (TFBS) and provided insights into putative role of Gibberellic acid and auxin on the expression of *OPR3* and *COI1*. Microsynteny analysis was employed to study gene conservation and rearrangements across Brassicaceae. Sequence divergence in coding and regulatory regions of *OPR3* and *COI1* from different species was analyzed to reconstruct phylogeny. This allowed us to understand the evolution of regulatory regions which would be helpful in planning of future strategies. The study thus forms basis for functional characterization of candidate genes for trait manipulation and induction of male sterility in members of Brassicaceae with complex polyploidy genome.

IMPROVING SOIL FERTILITY BY ORGANIC FARMING SYSTEM

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Agrochemicals that ushered in the 'green revolution during the 1950-60s boosted food productivity, but at the cost of environmental security and safety and has cause harm to important soil organisms and damaged the biological resistance in crops making them more vulnerable to pests and diseases. It though increased food production but destroyed the 'physical, chemical and the biological properties' of soil over the years of use. They exploited the beneficial soil organisms and also impaired the power of 'biological resistance' in crops making them more susceptible to pests and diseases. As a result, no farmland of the world is left free of toxic pesticide residues today. Considering the ill effects on natural resources and global marketing demand for quality products, there is a need to switch from an intensive chemical cropping system to an organic farming system. Manures and composts tend to increase soil organic matter content, reduce bulk density, increase porosity, generally improve aggregate stability, and significantly impact stabilizing vulnerable soils against erosion. As a result of increasing the soil organic matter content, composts and manures typically increase cation exchange capacity. An increased level of soil organic matter (SOM) is also a characteristic of good soil as it serves several essential functions like improving the soil structure, aggregation, water infiltration and over-all productivity that are especially important to organic agricultural systems. Furthermore, organic agriculture soil management often increases SOM, over time, whereas conventional agriculture generally lowers it. Therefore using of organic farming system enhanced the fertility of soil.

Keywords:Organic farming, soil organic matter, soil fertility.

IN-SILICO ANALYSIS OF ARABIDOPSIS NDL INTERACTOME WITH REFERENCE TO ABIOTIC STRESSES

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NDL (N-MYC Downregulated Like) Proteins are interacting partners of G-protein in Arabidopsis. Earlier studies indicate their role in abiotic stresses. Our in-silico approach revealed that many of the interactors of NDL1 proteins show response to abiotic stresses. Beside this we have also analysed (in-silico) the expression of interactors in various anatomical structures. Also, the network map (based on the putative roles of NDL-interactors in different processes and functions of plants) was created using the information available on open databases like TAIR, NCBI and research papers. Structure based docking analysis and in vivo physiological analysis are also planned to provide information regarding significance of these protein-protein interaction. This study would be helpful in further planning of experiments to check combined role of NDL interactome in dealing with abiotic stresses.

Keywords: abiotic, stress

EFFECT OF SEAWEED SAP ON YIELD AND ECONOMICS OF SWEET CORN (*Z. mays saccharata*)

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Sweet corn is one type of maize and contains 13 to 15% sugar in immature grains. Sweet corn is consumed at the soft dough stage with succulent grains, emerges as an alternative dish of urbanites namely, vegetable, roasted ears, soups, corn syrup and sweeteners etc. It also found a special niche in the preparation of native beer. Sweet corn can be harvested within 80 to 90 days after sowing. They are harvested earlier by 35 to 45 days compared to normal grain corn. Presently, greater emphasis is given to the cultivation of sweet corn due to increasing demand. Since there is limited scope to increase the area under sweet corn cultivation because of competition from other cereals and cash crops, the only alter-native is through enhancement of productivity by various management factors (Bhatt, 2012). Therefore, to evaluate foliar application of different sea weeds sap to enhance growth, yield and nutrient uptake of Sweet corn with this objective trial was conducted towards the balancing nutrients requirement for the optimum productivity of maize (Sweet corn) crop. A field experiment was conducted during the rabi season of 2012-13 at Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) to study the effects of seaweed saps on growth, yield, nutrient uptake and economic of maize (sweet corn) in *Matasi* soil of Chhattisgarh. The foliar spray of two different species (namely *Kappaphycus* and *Gracilaria*) was applied thrice at different interval of crop with different concentrations (0, 2.5, 5.0, 7.5, 10.0 and 15% v/v) of seaweed extracts. Foliar applications of seaweed extract significantly enhanced the growth, yield, nutrient uptake and B:C ratio parameters. The green cob yield (189.97 q ha⁻¹) and fodder yield (345.19 q ha⁻¹) were recorded highest under treatment (T8) 15% G Sap + recommended dose of fertilizer (RDF) which was significant similar with treatment 15% K Sap + RDF (185.24 q ha⁻¹) in case of green cob yield. The highest N, P and K uptake by green cob and fodder were observed under 15% G Sap + RDF (T8). Treatment 15% G Sap + RDF (T8), recorded maximum gross return (Rs. 2,07,230 ha⁻¹), net return (Rs. 1,38,756 ha⁻¹) and B:C ratio (2.0), which was followed by treatment 15% K Sap + RDF (T4) with net return (Rs. 1,33,199 ha⁻¹) and B:C ratio (1.95). Treatment 15% G Sap + RDF (T8) gave Rs. 45,996 ha⁻¹ more as compared to Water spray + RDF (T9).

Keywords: Gracilaria, Kappaphycus, Maize cob yield, Seaweed saps

ASSESSING THE COMPETING ABILITY OF WEEDY RICE (*Oryza sativa* F. *SPONTANEA*) WITH CULTIVATED RICE UNDER ELEVATED CO₂ CONDITIONS

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Climate change is one of the many risk factors that affect rice production and in the past decade, atmospheric carbon dioxide (CO₂) has risen from 369.25 to 400.26 ppm from 2000 to 2015. Rise in CO₂ clearly have an impact on rice especially on weed management on the wake of emergence and proliferation of newer weed species like weedy rice (*Oryza sativa* f. *spontanea*). The competitiveness of weedy rice having C₃ pathway in comparison to two popular rice varieties was

studied in an open top chamber (OTC) under a carbon dioxide concentration of 500 ppm (Chamber A), OTC without external CO₂ supply (Chamber B) and open condition with both air and soil temperature inside the chamber maintained at a higher level of 40-43⁰C and 35- 40⁰C respectively. Of the various growth and yield attributes analyzed, it was found that weedy rice responded well to elevated CO₂ compared to cultivated rice variety *Jyothi*, showing its highly competitive potential. There was differential response of rice varieties to elevated CO₂ condition with *Uma* responding well compared to *Jyothi*. Compared to ambient conditions (chamber B and Open condition), higher tillering was observed under elevated CO₂ (chamber A) in which weedy rice tillered profusely (17.33) than cultivated rice species. There was a linear increase in plant height of weedy rice in chamber A during initial stages and in chamber B during reproductive stages. This clearly indicated that weedy rice responded well to elevated CO₂ condition during the initial stages and at the reproductive stage response was more to the ambient conditions of chamber B. The study evidenced that in the coming future, higher CO₂ levels can stimulate biomass production of C₃ weed like weedy rice with greater increase in tillering which could be an important trait affecting inter specific competition.

Keywords: Climate change, crop-weed competition, elevated carbon dioxide, weedy rice

SAFFRON CULTIVATIO IN JAMMU AND KASHMIR AND DOUBLING FARMERS INCOME

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The rural economy employs about 60 per cent of India's work force, contributes about 17 per cent of gross domestic product. Average net profit of one acre of land growing cereals is about Rs 5,000 which gives a net profit of Rs 10,000 annually for 7 crore marginal farmers. Furthermore, the minimum support price for food grains is always lower than the real input costs plus minimum profits, resulting in two lakh suicidal deaths in India reported during the last one decade. It in this backdrop the union government has set an ambitious goal to double farmers' income by 2022 to boost the agriculture sector. The present paper has pursued the vision 2020 in Jammu and Kashmir state in respect of most profitable and world famous spice saffron. The highly priced spice is cultivated in state on an area of 4496 hectares. The crop has attempted to double the farmer's income by providing new technology in the form of growing material in saffron to the farmers, so that their socio-economic condition is uplifted. The results of the study revealed that not only the productivity of saffron has increased multi-fold but also the income of farmers has increased from Rs 204153 to Rs 604314 by using the new production system module developed by SKUAST-K

Keywords: Employment, income booster, improved quality of life, irrigation, profits

LABILE SEX EXPRESSION IN *Dodonaeaviscosa*, AN IMPORTANT INTER-CONTINENTAL SPECIES

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Flowering is crucial phenomenon that ensure reproduction and plants have evolved mechanism for better adaptability and genetic diversity. Reproduction in plants is affected by changing environmental conditions and hence needs an exhaustive study. Among different climatic conditions temperature plays significant role in controlling various reproductive processes including the onset of flowering. *Dodonaeaviscosa* (sapindaceae) is an inter-continental species distributed over six continents. It is an evergreen woody perennial shrub distributed over a wide range of habitats. It has lots of ecological significance owing to its occurrence in a wide range of habitats, resistance to drought, chill and frost. It reduces environmental pollution by its sticky and viscous leaves. It has immense medicinal value. During our work on *Dodonaeaviscosa* in two seasons, some interesting observations were recorded with respect to flowering, prolonging of reproductive phase and change in sex expression with change in temperature. Predominately the species is diecious. As the temperature recede, some male plants were observed to change their expression to andromonoecy i.e. they also starts bearing hermaphrodite flowers. This dynamics of changing sex expression is the subject of paper during presentation where details will be presented.

**EVALUATION OF ANTIMICROBIAL ACTIVITY OF
Dermatocarponvellereum ZSCHACKE**

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Lichen represents two organisms as a single entity. Lichens are the pioneers of ecosystem and also are repository of complex and unique compounds and genes. Like other living organisms, they also produce primary and secondary metabolites. Secondary metabolites are responsible for the production of small and complex structure i.e. Polyketides. Antibacterial, antifungal, antiviral, antiprotozoal, anti-mutagenic, antioxidant, anti-inflammatory, antipyretic and antioxidant activities are exhibited by polyketides. *Dermatocarponvellereum* Zschacke is one of the commonly known foliose lichen, which was evaluated for its antimicrobial potential against human and animal infecting microbes. The antimicrobial effect of solvents (ethanol, methanol and acetone) extracts of the species were investigated *in vitro* against microbes. The results will be discussed in details during the presentation.

Keywords: Lichens, Polyketides, Antimicrobial

BIOLOGY OF *Zeugodacus tau* (WALKER) (DIPTERA: TEPHRITIDAE) ON BOTTLE GOURD

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Zeugodacustau Walker (Diptera: Tephritidae), native to Asia, is an economically important pest of agricultural crops. In Asia, approximately 30–40% losses of agricultural products are caused by *Z. tau* infestation every year. The biology of fruit fly *Z. tau* was studied under laboratory conditions at 25°C and 60-75 % relative humidity on *Lagenaria siceraria*. The female laid about 57-92 eggs in small batches approximately 2-4 mm below the exocarp of fruit. Eggs were shiny white, smooth, slightly curved, elongate, tapered anteriorly and turning darker as hatching approached. Morphometrics of different life stages of *Z. tau* revealed that the average length and breadth of egg measured 1.26±0.15 mm and 0.24±0.04 mm, respectively. The first and second instar maggots measured 2.68±0.98 and 5.65±1.23 mm in length and 0.42±0.12 and 1.29±0.12 mm in breadth. The full grown third instar maggots exhibited a peculiar habit of hopping into the air and their length and breadth was 9.16±1.05 and 1.84±0.49 mm, respectively. Average length and breadth of prepupa and pupa was 6.74±0.43 mm, 2.13±0.19 mm and 5.48±0.35 mm, 2.31±0.24 mm, respectively. Adult wings exhibited a distinct spot at apex and mean length and breadth of male was 7.76±0.75 mm and 13.85 ± 1.40 mm, whereas, the female measured 9.24±0.78 mm in length and 16.55 ± 0.69 mm in breadth. The duration of incubation, maggot, prepupal and pupal period were 2.3±1.35, 5.8±2.11, 0.95±0.55 and 8.2±1.31 days, respectively. The pre-oviposition, oviposition and post-oviposition period were 12.1±1.28, 16.3±6.8 and 2.4±0.7 days, respectively. Fecundity of the female was on an average about 73.6±15.0 eggs, while egg viability was 83.0±3.4. Adult male and female longevity was 28.4±2.6 and 31.6±1.1 days, respectively.

Keywords: *Zeugodacus tau*, biology, *Lagenaria siceraria*, fruit fly

EFFECT OF THE COLOUR AND HEIGHT OF STICKY TRAPS IN ATTRACTION OF *Thrips tabaci* (LINDEMAN) (THYSANOPTERA, THIRIPIDAE) ON ONION

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Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera, Thripidae), is a well-known onion pest worldwide. Onion thrips cause direct and indirect damage to onion by feeding and ovipositing on leaves that may cause onions to be unmarketable and dry bulb size to be reduced.

In the present study, efficiency of colour and height of sticky traps were evaluated to identify the ideal trap colour for the attraction of adults and nymphs of onion thrips in onion field during the growing season in 2018-19 at research field of Wadura campus, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, India. Three replicates of yellow, white, green and blue sticky traps were mounted in four different heights (25, 50, 70 and 100 cm) in onion field. The sticky sheets were examined every week, replaced and transferred to the laboratory for more

investigation and counting, segregation and identification of the captured insects. Target insects showed different reaction to the colour of traps in this study. Seven days after installation of trap (DAI), significantly maximum number of thrips (12.65/card) was recorded on yellow trap, followed by blue and green trap. The minimum catch was observed on white sticky trap (3.77/card). Similar trend was observed at 14, 21, 28 and 35 DAI. Mean comparison indicated that the traps ordered in their attraction to nymphs and adult thrips as yellow>blue>green and white colour traps. Mean comparisons showed that installed traps at 100 cm above the ground attracted more nymphs and adult thrips, while the traps at the heights 75, 50 and 25 cm were in consequent orders in trapping of nymphs and adult thrips. Based on the results of the present study, installed traps at 100 cm were suitable for catching nymphs and adult thrips. The results of the current study indicated that yellow colour traps which were installed at 100 cm above the ground were the suitable choice for monitoring the onion thrips. Regarding attraction of beneficial insects to colour traps, maximum number of damsel flies (Predators) got trapped on green sticky trap (10.55/card), followed by the white trap (7.12/card) at 35 DAI (days after installation). The yellow sticky trap was less attractive to damsel flies (1.39/card) and thus exhibited its suitability over other colour sticky traps.

Keywords: *Thripstabaci*, monitoring, sticky traps, *allium cepa*, IPM

PRODUCTION POTENTIAL OF DIFFERENT KHARIF FODDER CROPS UNDER SOUTHERN AGRO-CLIMATIC ZONE OF ANDHRA PRADESH

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Field experiment was conducted during kharif season of 2017-18 at Livestock Farm Complex, College of Veterinary Science, Proddatur to evaluate the performance of fodder crops/varieties. The treatments consist of 6 fodder crops/varieties i.e. Co.Fs.29 jowar variety, SSG-898 jowar variety, bajra, sunhemp, horsegram and pillipesara. Highest values of plant height, Leaf area index and forage yield were obtained from Co.Fs.29 jowar variety. Pillipesara was significantly recorded the lowest values of growth and yield parameters.

Keywords: kharif fodders, Co.Fs.29 jowar variety, southern agro-climatic zone of Andhra Pradesh

ERGONOMIC ASSESSMENT OF MUSCULOSKELETAL DISCOMFORT AMONG STONE LOAD CARRYING WORKERS AT HILLS

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At hills stones are widely in use for various purposes including construction of houses, buildings, walls and roads. Workers have to perform various tasks in which manual stone load carrying activity is one of hazardous one. Therefore the present study was planned to assess the types of stone loading practices and related musculoskeletal discomfort among workers in Nainital district of Uttarakhand. A total of 120 workers were involved in the study with no history of chronic disease. A well standardized Nordic Questionnaire was used for assessing Musculoskeletal discomfort among workers. The results revealed that carrying heavy loads on head and shoulder was a common

practice followed by workers. It was found that there was not any ergonomically designed tools or devices were used by workers for load carrying. They were not using any Personal Protective Equipment (PPE) while performing tasks. Therefore the risk of musculoskeletal discomfort was high among workers. They were suffering from pain in various body parts specially in head, neck shoulder, lower back and knee while carrying loads on head and shoulder. Lifting and carrying heavy loads on head cause chronic low back pain in some of the workers. It was recommended that safety measures should be utilized including ergonomically designed helmet or head support and safety shoes with non- skid soles at workplace. It was concluded that carrying heavy loads on head may increase the risk of degenerative changes in the upper cervical spine of the workers in near future.

Keywords: musculoskeletal discomfort, pain, loading, lifting, workers.

STUDY ON SPACE CHARGE LIMITED CURRENT FLOW IN INSULATOR

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The one carrier injection in insulator is well known from several decades with the help of suitable metallic electrodes. Such studies were observed under the great varieties of structures obtained in the inner part of the insulators due to the different configuration of carrier mobility and other physical parameters. The various structures in the current flow regime in insulators are obtained through the current injection technique which is a powerful tool to provide the sufficient information's regarding the defect states of the insulators. The space-charge-limited current flow mechanism in insulator is of great interest due to the recent research programmes opening the new promising directions in the research field of solid state electronics. A sufficient amount of research work is available in literature for the background of the subject matter. The sufficient number of the trapping states are present in the forbidden gap of the insulators. It plays important role in the study of space charge effects on insulating materials operating under different carrier mobilities and current flow geometries. The important inferences from the analysis of the several workers have shown that the carrier mobility configuration play an important and interesting role in the electrical transport technologies in these insulators. The electrical behavior of single injection current flow in insulators depends greatly on the carrier density of free current carriers in solids. The important and vital role of insulators in electronics is to fabricate the electrical devices derived from the insulator. The important information's are obtained due to the interaction of the current carriers with the presence of trapping states and thermal free carriers in the insulators.

Keywords: Insulator, carrier density, trapping states and Current Carriers

GREEN THUMBS GET AN ORGANIC IMPRINT: A GOODNESS OF CASE STUDY ON ORGANIC FARMING

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The research study aimed to identify the extraordinary and unique farmer who was leading success in the field of organic farming. The objective of this case study is to bring out and narrate the facts

which had been adopted by the case to run the successful model for sustainable agriculture. Meeting was conducted during 2019 -2020 at Dommeru village of kovvurumandal West Godavari district Andhra Pradesh and identified & selected Mr Neerukondasatyanarayana as the case for research. N satyanarayana was a progressive farmer who has 100 percent successful in farming of banana, vegetables ,black gram and papaya through organic farming. Case study type of research was done and the relevant data pertaining to profile, skills, work experience, knowledge of the agripreneur in the field of agriculture and its allied sectors was collected by using a semi-structured interview schedule. Thus, the study gives a solution to efficiently utilize the available resource by means of organic farming. The focus of the study was to highlight the effectiveness, adoptability and economics. Mr.satyanarayana was a successful progressive farmer of West Godavari district. He had established his business in agriculture and gained good profit. Banana, Papaya, Vegetables (Brinjal, Tomato, chilli and Spine gourd) and Black gram crops cultivated in 10 acres of area and reared four cows, six buffalos and 130 poultry birds. He prepared 14 types of organic inputs (Beejamrutham, Ghanajivamrutham, Dravajivamrutham, panchagavya, Agniastam ,Neemastram, vavilaku, Panchapatra, Dasaparni, Sontipala ,Saptankurakasayam, Fish amino acids, Egg and lemon amino acids , Starch liquid), bio fertilizers(PSB, zinc and sulphursolubilising bacteria, Azospirillum), bio pesticides(*Beauveria bassiana*, *Verticillium lacanii*, *Metarhiziumanisopliae*, *Trichoderma viride* and *pseudomonas fluorescence*) on his farm. He developed low cost semiautomatic poultry egg hatcher unit Used for the incubation of eggs into chicks in 21 days and Incubator capacity is 50 eggs. By adopting organic practices he got net income of Rs.3 lakhs /ac from Vegetable cultivation from banana 1.5 lakhs /ac in case of Black gram Rs. 35000/ac as net income. in case of papaya till now he harvested 3 tonnes value of 60000(20000/tonne) rupees still he need to do harvesting of papaya. by seeing his success 45-50 farmers adopt organic farming practices in their fields. The motto of this farmer was to bring back all the exploited soil and environmental resources and improve soil fertility, so he promoted agriculture and allied sectors through organic farming in a sustainable way. This case study can be cited as the best example for a successful agripreneur.

Keywords: organic farming, organic inputs and net income

**USE OF BIOPESTICIDES FORMULATIONS FOR SAFER ENVIRONMENT
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Bio-pesticides are usually inherently less toxic than conventional pesticides. They generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects, and mammals. They often are effective in small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. When used as a component of Integrated Pest Management (IPM) programs, bio-pesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. To use bio-pesticides effectively, however, users need to know a great deal about managing pests. Selection of the appropriate formulations that can improve product stability and viability may reduce inconsistency of field performance of many potential biological control agents. A suitable formulation should provide a

protective habitat for the introduced bacteria, thereby increasing then potential for survival and successful. The interesting feature of bio-pesticides is environment friendly and easy biodegradability. In terms of production and commercialization also, bio-pesticides have an edge over chemical pesticides because they involve low research expenditure and have faster rates of product development. Though there are about 140 bio-pesticide production units existing in the country as on today, they are able to meet the demand of only less than 1% of cropped area. There exists a wide gap, which can only be bridged by setting up of more and more units for production of bio-pesticides.

Keywords: Bio-pesticides, IPM, bacterial formulations

REPERCUSSION OF ELECTROLYZED WATER ON SEED DECONTAMINATION AND SEED PHYSIOLOGICAL PARAMETERS

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Electrolyzed water (also known as electrolyzed oxidizing water or electro-activated water or electrochemically activated water) is produced by the electrolysis of ordinary tap water containing dissolved salt (sodium chloride or potassium chloride or magnesium chloride). The resulting water used as a cleanser and disinfectant/sanitizer. The electrolysis of salt solutions produces two types of electrolyzed water such as 1. Electrolyzed reduced water (Basic electrolyzed water) and 2. Electrolyzed oxidized water (Acidic electrolyzed water). Electrochemically activated water was initially developed in Japan. Electrolysis technology is now regarded as a promising non-thermal treatment for hygiene control. It can be produced on-site and it is more environments friendly. Electrolyzed water possesses strong bactericidal and viricidal and moderate fungicidal properties. Neutral electrolyzed water slightly increased the germination percentage and reduced the *Fusarium* and *Aspergillus* population in tomato seeds. Alfalfa seeds treated with acidic electrolyzed water reduced the *Enterobacteriaceae* population on seed and seedling. Electrolyzed water increased the hypocotyl length and hydrolytic enzyme activity in triticale. It also improved the γ -aminobutyric acid accumulation in brown rice. Electro-activated water treatment may be used as an effective method for reducing microbial contamination on seed and also improving the seed physiological parameters. Acidic electrolyzed water shows wide range of fungicidal activity, which may facilitate its use as a contact fungicide on aerial plant surfaces. Hence, electrolyzed water can be used to decontaminate the seeds and improve the seed physiological parameters. The use of electrolyzed water is an emerging technology and the door is open to further research and development.

Keywords: Electrolyzed Water, Disinfectant, Bactericidal activity, Fungicidal activity, Seed germination

**EFFECT OF FOLIAR APPLIED ZINC AND COPPER ON PHYSIOLOGICAL AND BIOCHEMICAL ACTIVITIES OF VEGETATIVELY PROPAGATED *Bacopa monnieri*(L.)
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A field experiment was conducted in GBPUAT, Pantnagar 2019-2020 to study the “Effect of foliar applied Zinc and Copper on physiological and biochemical activities of vegetatively propagated *Bacopa monnieri* (L)”. Brahmi an important medicinal herb known for the presence of characteristic saponins called “bacosides”. All parts of the plant are used as a medicine. Copper and Zinc is an essential plant micronutrient that plays a crucial role in plant growth and development as it acts as an essential co-factor for various enzymes involved in different metabolic pathways. The experimental study showed that Zinc and Copper application significantly enhanced the physiological and biochemical activities up to the optimal concentrations when compared with the control. This increase may be correlated with increased in the herbage yield. The study found that treatment Zn (2.5 ppm) led to a significant increase in MSI % and RWC % when compared with control. It is showed that the MDA content higher in response to Zn (2.5 ppm) treatment followed by (1 ppm Cu + 2.5 ppm Zn) when compared to control. While, total protein content recorded higher at the Zinc (2.5 ppm) and (1 ppm Cu + 2.5 ppm Zn) concentrations used. These results indicate that the application of Zn and Cu in optimum level could be considered for *Bacopa* crop to improve quality and yield.

Keywords: Medicinal herb, Bacosides, Micronutrients, Herbage yield,

ISSUES AND IMPORTANT FEATURES OF ANIMAL HEALTH

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The Veterinary Services are stated as they “key players in prevention and control of animal diseases and in the improvement of food security. In animal, health may be defined as the absence of disease or the normal functioning of an organism and normal behaviour based on the observation of a certain number of individuals that determine the standard and thus health. In production sectors, health also may be defined as the state allowing the highest productivity. However, this narrow definition often is enriched by the concept of a balance between the animal and its environment, and of the animal’s physical welfare. Multifactorial diseases are provoked by a set of risk factors linked in particular to livestock management with at times the participation of pathogens widespread in livestock known as “production diseases”. Multifactorial diseases are present on a large majority of livestock farms with highly variable frequencies. The opinion of experts and a critical reading of the literature had led to the following observation. international bodies (WHO, FAO, OIE) affirm that, over and above the threat of disease that can be transmitted to humans (zoonotic disease), the challenges facing the field of animal health are considerable. The challenges facing animal health, beyond those posed by zoonotic disease, overlap with those of public health and the environment, notably regarding the use of xenobiotic and the development of antibiotic resistance. The “one Health” approach is important insofar as it argues that the management of health requires reinforced coordination between human and animal components and, in the same manner, in-depth collaboration between biomedical and animal health research.

Keywords: Challenges, Animal, Health. Disease, Production

MONITORING OF *Spodoptera litura*, AND *Helicoverpa armigera* : A EFFECTIVE MEASURE OF IPM SYSTEMS FOR SUSTAINABLE MANAGEMENT OF KEY PESTS OF GROUNDNUT

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A field experiment for Monitoring of *Spodoptera litura*, and *Helicoverpa armigera* using pheromone traps was laid out in non-replicated design at experimental farm of Oilseeds research station during *Kharif* 2012 using LGN-1 variety of groundnut with object to record inception of the adult moths and the peak of moth catches. In the present study monitoring of observations of *Spodoptera litura* and *Helicoverpa armigera* adults was carried out from July to October by using pheromone traps on weekly basis. The adult moths caught per trap indicated that the inception of moths started from 32nd MW. The highest number of *Spodoptera* and *Helicoverpa* adults were caught in 37th and 35th MW i.e. 193 and 200 adults/ trap when the corresponding weather parameter where minimum 20.9 and maximum temperature 27.4, Rainfall 21, rainy days 1, relative humidity –I 80 and relative humidity –II 74 and minimum 20.3 and maximum temperature 26.2, Rainfall 59, rainy days 4, relative humidity –I 87 and relative humidity –II 70 respectively thereafter there was decline in adult catches in pheromone traps.

Keywords: Groundnut, *Spodoptera litura*, *Helicoverpa armigera* and pheromone traps

TRADITION IN TRANSITION: THE TRANSFORMATION OF TRADITIONAL AGRICULTURE IN ARUNACHAL PRADESH, INDIA

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Jhum cultivation also known as “slash and burn agriculture”, a popular form of agriculture practice that has been practiced for a long time and was the mainstay of livelihood for the indigenous tribal people of Arunachal Pradesh. The growing population and increase in demand for food supply have led to a shorter cycle of jhumming which eventually led to less production and low fertility of the soil. Recently, it has been observed that, majority of farmers have shifted their attention towards traditional agroforestry practices which are found to have more ecological and economic benefits providing a year-round production. The traditional way has been maintained even if there has been a transformation, as the local farmers are afraid to risk the adoption of modern agroforestry since it is more complex as compared to the existing traditional system of agriculture. A preliminary survey was conducted in three districts namely, Kradaadi, Lower Subansiri, and Papumpare, inhabited majorly by the Nyishis, which is also the largest tribe of the state to assess the imperative of agroforestry practices in terms of socio-economy, livelihood, food security, and the existing constraints hampering the development of agroforestry practices. The traditional agroforestry has replaced the old way of Jhumming which is found to have declined to at least 70-80% for the last 10-15 years. Still, small pockets of the region practiced slash and burn which definitely brought earnings to the rural folks but with more disadvantages as compared to the ones who practiced traditional agroforestry. The practice of traditional agroforestry had numerous social, environmental, economic benefits that led to the growth of its adoption and better sustainability.

Keywords: jhum, traditional agroforestry, socio-economy, Arunachal Pradesh, livelihood, tribal

CROP DIVERSIFICATION IN COFFEE ESTATES OF NORTH EAST INDIA: A WAY-OUT FOR DOUBLING FARMER'S INCOME

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The north east India is primarily an agriculture based economy. Around three fourth of the region is hilly and mountainous. The cultivable land is quite limited due to difficult terrains and large forest cover. The agricultural productivity is generally low, as the topography does not permit Intensive use of irrigation and modern inputs. In such situation, crop diversification with coffee seems to be suitable strategy to enhance farmer's income. Low agricultural productivity in most areas of north east India is due to predominance of mono- cropping system. Crop diversification is a way to increase diversity in an agricultural ecosystem and to give stable returns even under unfavourable weather conditions. Presently, the north eastern states have about 8696 ha of coffee area. In this region, coffee is grown under shade and intercropped with various fruit trees and spices to provide shade, food and additional income. The impact of these intercrops on coffee production is little known and hence the need for the study. The study was carried out at Diphu, KarbiAnglong district of Assam. The aim of the study was to find out the extent of intercropping in coffee, cultivation methods to be followed and, its overall impact on yield and farm income. During the study, observations were recorded on area under coffee and different crops, inputs used, expenditure, and output of different crops both in quantitative terms and in monetary value. The study concluded that diversification of coffee with fruit crops and spices like banana, areca, jackfruit, betel vine and black pepper increased total crop yield, enhanced net income and benefit cost ratio. Therefore, wider adoption of intercropping system in coffee can be recommended for increasing crop yield and enhance the economic returns from unit area.

Keywords: Diversification in coffee, coffee production, farm income

PERFORMANCE AND RANKING OF SOYABEAN GENOTYPES UNDER ACIDIC SOIL CONDITION IN MEGHALAYA USING HYDROPONIC TECHNIQUES

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In the world scenario, although soybean is considered an important oilseed crop with India holding 5th position by contributing about 3.95% share in it's total production, its production in north-eastern region of India especially in Meghalaya is quite less due to its acidic soil condition. This necessitates the requirement of better performing genotypes along with the study for genetic diversity of genotypes to develop new and improved cultivars. With the highlight of the above fact, the present research was conducted using 40 different soybean. Two concentrations of 25 μ M and 75 μ M were used along with the re-growth study. Different ranking of the genotypes found for different concentration under Al treated solution. The ranking of genotypes based on yield performance was closely related with ranking based on the re-growth length of the genotypes after treatment. The result showed genotype TS 53 as tolerant genotype followed by the genotype JS-335 and MACS-1493. Based on the re-growth study, genotype TS 53 with more re-growth ability

followed by the genotype MACS 1493 and SL 1068. Least re-growth ability found in the genotype MAC-1575, NRC 130, RSC 11-07. With these findings, it will be useful for breeders to further undergo molecular level studies to find out the gene responsible for tolerance. Also, the genotypes showing tolerance to Al toxicity could be used for further molecular and field analysis and helpful in faster screening of the genotypes under acidic condition.

Keywords: Acidic soil, soybean, hydroponics, aluminium toxicity

RETRIEVING HEAVY METALS THROUGH GREEN TECHNOLOGY - PHYTOMINING

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Heavy metal pollution is a worldwide concern and the number of contaminated sites is increasing with passage of time due to burgeoning population, disarrayed industrialization and expanding economics. These heavy metals will end up in the food chain, bio-accumulate and transfer from one food chain to another. It is essential to remove the heavy metals from the environment for clean-up of the soil and several technological options are available for this. One of the promising technologies is 'phytoremediation' whereby living plants are used to clean up the contaminated soil. Phytoremediation can be defined as the bioremediation process that uses various types of plants to remove, transfer, stabilize, and/or destroy contaminants in the soil and groundwater. The different types of phytoremediation mechanisms can be further classified as phytodegradation, phytovolatilization, phytosequestration, rhizo - degradation and phytoaccumulation. Plants take up or hyperaccumulate contaminants through their roots and store them in tissues of stem or leaves. These metals can be recovered for reuse by incinerating the plants in a process called phytomining. The plants which are able to accumulate metals are known as hyperaccumulators. Eg. Indian mustard (Au), Sunflower (As), Water hyacinth (Cr), Milkwort jewel (Ni) etc. Once the plants accumulate the metal, it can be recovered by ashing. Ashing is followed by direct melting or reduction roasting, the slag is removed and the metal recovery is more than 90 per cent. Quantification of metal extracted by phytomining is also possible by computing bioconcentration factor (BCF), translocation factor (TF), accumulation factor and removal ratio. Phytomining offers the possibility of exploiting metals from low-grade ores, mill tailings or mineralized soil that is uneconomic by conventional mining methods. It is an environment friendly, aesthetically pleasing, non-invasive and non-destructive technology that has high probability of public acceptance. Phytomining also complements the global supply chain for critical minerals. It generates considerable revenue for the grower besides providing mineral supplementation and increased soil health. Hence, it can be considered as a green technology. It has the possibility to be improved by discovery of fast-growing plants with high biomass and ability to accumulate high concentration of metals in harvestable parts. Many genes are involved in metal accumulation, translocation and sequestration and, transfer of any of these genes into candidate plant is a possible strategy for genetic engineering of plants for improved phytoextraction traits.

Keywords: Environment, heavy metal, hyperaccumulate, phytoremediation, phytomining, quantification

PARTICIPATORY CROP IMPROVEMENT PROGRAM

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Participatory crop improvement (PCI) is an alternate approach to formal crop improvement (FCI) programmes; here later implies to crop improvement carried by breeders at research stations and the former refers to such crop improvement where farmers are encouraged to participate in the research programmes. PCI acts like a platform where a farmer can interact and learn from plant breeders by becoming part of research programme. It's a concept, conceived with the purpose of benefiting farmers of marginal areas or the marginal environment. The marginal area or environment here implies to those areas where agriculture is in influence of the socio-economic conditions and it also affects the agro-ecology of that area. Participatory plant breeding (PPB) and Participatory varietal selection (PVS) are two forms of PCI According to Hardon (1995), PCI is a link between the local and formal system of crop development aiming to improve the productivity and complements capacities of farmers and acknowledge their contribution to agriculture and germplasm conservation. Functional approaches of PCI can be used in improving communication between researchers and farmers in order to improve the design of technology and its acceptability, awareness, and adoption, as breeders always look forward to identify traits favored by farmers in the breeding programme.

Keywords: Participatory crop improvement, formal crop improvement, research programme, Participatory plant breeding, Participatory varietal selection

SHIITAKE THE SOURCE OF MEDICINAL AND NUTRITIONAL PROPERTIES

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Mushroom are increasingly considered as a highly prized next generation foods owing to its high nutritional and medicinal property and consumer demands for mushrooms markedly expanded in the recent years. It is known from before as it is used in traditional oriental therapies. Mushrooms have long been prized as highly nutritious foods by many civilizations in the world. Recent research has found out different ancient knowledge. Several mushroom products developed with clinical commercial applications are D-fraction from *Grifoliafrondosa*, *lentinan* from *lentinula edodes sonifilian* from *Schizophyllum* commune etc. Different Mushrooms has different properties of nutritional and medical purposes content was studied. They have been found to have various potential of Anticarcinogenic and Antitumor Effects, Hepatoprotective Effects, Immune-Modulating Effects, Cardiovascular Effects, Anti-thrombotic Effects, Antihypercholesterolemic Effects, Antihypertensive Effects, Antiobesity Effects. Out of the entire mushroom studied for medicinal properties shiitake has unique advantage with rich culinary and medicinal properties. Shiitake has a history of medicinal uses. The mushroom is used as anticarcinogenic, antiinflammatory, antioxidant, antifungal, antibacterial, antiviral as well as antithrombotic in cardiovascular disorders. This abstract has written to know some value on Shiitake mushroom

which has many medicinal and nutritional values. Many fresh Shiitake came in market containing the active ingredients which can replace other marketed synthetic medicines and to show beneficial results with very less side effects.

Keywords: Medicinal, Mushroom, Nutritional, Shiitake

COMPARATIVE STUDY OF VARIOUS MOLECULAR TECHNIQUES

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Different molecular diagnostics techniques such as enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR), real time-polymerase chain reaction (RT-PCR) and DNA-labeled hybridization probes have been developed or implemented for the routine detection of various diseases including biological indexing. However, most of these diagnostic methods are time consuming and requires sophisticated laboratories, skilled manpower, not user-friendly and complex procedures as well as thermal cycler. In contrast to the existing amplification techniques, Recombinase polymerase amplification (RPA) is simple, cost-effective, rapid, user-friendly and sensitive. Thus, RPA was able to detect the target virus when the template was in crude extract while PCR was not. PCR has become one of the most commonly-used nucleic acid based methods for the detection of plant pathogens due to its speed, specificity and sensitivity but the disadvantages of PCR/RT-PCR for detection are the dependence on a thermo-cycler and the time investment per sample. While RPA employs a single primer pair and operates satisfactorily over a convenient temperature range (39-45°C). RPA can also perform much faster and more cost effective assay than PCR. Thus, RPA could prove great potential to provide an improved diagnostic tool for detection of plant viruses.

Keywords: Molecular diagnostics, Pathogen, Polymerase chain reaction, Recombinase polymerase amplification

BANANA STREAK VIRUS: A MAJOR THREAT TO BANANA GROWN IN INDIA

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Banana is a monocotyledonous flowering plant that belongs to the genus *Musa* of the family Musaceae in the order Zingiberales. Banana is one of the most important fruit grown in India. Banana streak disease is caused by a complex of different banana streak virus (BSVs) which is found to occur in all the banana producing countries. BSVs are genetically quite diverse and can exist both as episomal forms or integrated into the host genome and both can be infectious to

banana. Several reports and studies about the infectivity of one or more BSV species on different banana genotypes with significant differences in virus incidence and symptom expression between and within genotypes were reported. So, this study has been focused on PCR based indexing of the endogenous banana streak viruses (eBSV) species, on banana plants of different genotypes. PCR based detection of eBSVs (eBSGFV, eBSIMV and eBSOLV) showed the amplification at Junction, Internal and Allelic Markers in all the genome groups. These give an indication that the entire genome group has eBSVs integrated into the host genome. Classification of eBSOLV showed that the eBSOLV1, which contains the full-length BSV genome at least once, was detected in BB and ABB genome group. A multiplex PCR for the detection of eBSV of the three species viz. eBSGFV, eBSIMV and eBSOLV were also developed. Banana streak disease has been one of the major threat to breeding programmes and tissue culture industries of banana in India. Its management largely depends on the availability of accurate, sensitivity, low cost and robust diagnosis of BSV infection.

Keywords: Banana streak virus, Molecular diagnostics, Multiplex, PCR

PERSONAL, SOCIAL AND ORGANISATIONAL STATUS OF AGRICULTURAL EXTENSION PERSONNEL IN REVITALIZED EXTENSION SYSTEM

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In India public extension system will have to be placed in new decentralized institution arrangement which are demand driven, farmer accountable, bottom up and have farming system approach. Due to several constraints and weakness in system the multifaceted demand of the farming community is compromised. So, it was realized that the present public sector extension system would be reformed to meet the farmer's technological requirements. It was felt that extension system should be made broad-based and holistic by utilizing a farming system approach and involving various stakeholders. The present study was undertaken in 2017-2018 in 4 District (Imphal east, Imphal west, Thoubal and Bishnupur) of Manipur to access the personal, social and organizational status of the extension personnel (Assistant technology manager) in revitalized extension system. All the 54 respondents who were working as Assistant technology manager in 4 Districts are selected using multistage purposive sampling method and the respondents were interviewed with the help of structured schedule. The study revealed that majority (72.22%) of the respondents belonged to the middle aged category (26-38 years), followed by 14.82 per cent in old aged (39-50years) and (12.96%) in young aged category (23-35years). Majority (74.07%) of the respondents were M.Sc. (Agri.), followed by (22.22%) were B.Sc. (Agri.) passed and (3.71%) were Ph.D. degree. Majority (42.59%) of the respondents have 2to4 years of service experience followed by 38.89 per cent and (18.52%) with 1 year and below 5to7 years of service experiences respectively. Majority (37.03%) of the respondents had exposure to 1to4 number of training followed by 35.19 per cent respondents with above 5to15 number of training and the least (27.77%) had exposure to 16to18 numbers of training. It is reveal that (87.04%) of the respondents had medium level of decision making ability followed by 7.41 per cent of respondents who had low level of decision making ability. The least (5.55%) number of participants had high level of decision making ability, all (100%) of the respondents had medium level of role perception. Majority (51.86%) of the respondents had favourable attitude towards ATMA an equal proportion (24.07%) of the respondents had less favourable and highly favourable attitude towards ATMA. Majority (64.81%) of the respondents had moderate level of job satisfaction followed by (18.52%) and (16.67%) had low and high level of job satisfaction. Majority

(64.81%) of the respondents had medium level of job anxiety followed by 20.37 per cent and (14.83%) respondents with high and low level of job anxiety out of 54 respondents majority (64.81%) of the respondents had medium level of achievement motivation followed by 18.52% respondents who had low level of achievement motivation

Keywords: ATMA, Assistant technology manager, interview schedule.

EFFICACY STUDY OF DIFFERENT PLANT OILS ON GROWTH OF BACTERIAL WILT PATHOGEN (*Ralstonia solanacearum*) OF *Capsicum annum*

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Ralstonia solanacearum (Smith) Yabuuchi *et al.* is considered one of the most destructive plant pathogens in tropical, subtropical and temperate regions worldwide. It is a highly diverse and adaptive bacterium that differs in host range, geographical distribution, pathogenicity, epidemiological interactions and physiological properties. Bacterial wilt in capsicum caused by *Ralstonia solanacearum* is a global problem. It is difficult to control the bacterial wilt caused by *Ralstonia solanacearum* as it survives for longer period in soil, moves along with water and has wide host range. Owing to its no toxic residual effect, high target specificity and eco-friendly nature of the plant oils, different plant oils were tested for their efficacy in suppressing the growth of the pathogen *Ralstonia solanacearum* in laboratory condition by inhibition zone technique in this research study. The experimental results revealed that, among the plant oils tested at 100% concentration, clove oil (*Syzygium aromaticum*) gives the best inhibitory effect to *Ralstonia solanacearum* with 33.99mm inhibition followed by karanj oil (*Pongamia pinnata*) with 15.66mm while the least inhibition is shown in case of sesamum oil (*Sesamum indicum*) with only 8.44mm inhibition zone against the test pathogen. Hence, further assessment through field trials is needed to check the effectiveness of the plant oils in suppressing the growth of the bacteria so that bacterial wilt of capsicum can be effectively managed.

Keywords: *Ralstonia solanacearum*, Capsicum, Bacterial Wilt, Plant oils, Management

BIOCHAR- A WAY TO IMPROVE SOIL QUALITY

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The whole world is now facing the issues of food security, climate change and declining soil fertility. In order to feed the ever increasing population, the soil fertility of agricultural land is depleting through intensive farming with high inputs like fertilizers, pesticides and other harmful chemical. With the introduction of new technologies like biochar production through pyrolysis (heating of organic material at 300-1000°C in the absence of oxygen) can lower such issues with some extent. Biochar application, as soil amendment, can increase soil pH, moisture holding

capacity, cation exchange capacity and microbial diversification that improves the overall soil quality. It has high stability against decay (can stay for longer time in soil and provide benefit to the soil) and can also retain more nutrients effectively for plant use. Thus, application of biochar had positive effect on the interaction between soil-plant-water leading to improve nutrient and water used efficiency. It can also be used for long term restoration of carbon sink.

Keywords: Biochar, pyrolysis, cation exchange capacity, moisture holding capacity

ADOPTION BEHAVIOUR OF JUTE GROWERS IN KOSI REGION OF BIHAR

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Jute is regarded as India's golden fiber and is predominantly grown by farmers of Eastern India. Jute requires a warm and humid climate and can be grown within a temperature range of 24°C to 37°C and a relative humidity of 57% to 97%. Jute crop thrives well with alternate rains and sunshine. The major raw jute producing states are West Bengal, Bihar and Assam that account for around 98 percent of the total of the country production. The present study was carried out in Kosi region of Bihar. Three district of this region were selected and total sample size was 90 jute growers for the study purposes. Face to face interaction with the help of well prepared interview schedule was used for collection of information. The collected data were analyzed with the help of frequency distribution, mean, standard deviation and Pearson's correlation coefficient. The study revealed that majority i.e. 57.77 per cent of the jute growers were having medium level of adoption of jute production technology followed by 23.33 and 18.90 per cent of the respondent were having higher and lower level of adoption of jute production technology respectively. In different practice wise Adoption of jute cultivation practices, majority of the farmers have adopted field preparation (64.44%), use of recommended seed and sowing method (55.55%), irrigation management practices (50%), use of manure and chemical fertilizer management (46.66%), and less number of farmers have adopted seed treatment with fungicide (11.11%), application of weedicides (26.66%), plant protection measures (27.77%), and post harvest technology including marketing (16.66%). The study also revealed that out of ten independent variables, eight variables i.e. education, land holding, annual income, extension contact, mass media exposure, scientific orientation, economic orientation and risk orientation shows positive significant relationship with the adoption level of jute growers towards jute cultivation practices.

ABIOTIC AND BIOTIC STRESS MANAGEMENT TO MITIGATE CLIMATE CHANGE GREEN TO GRAIN: STAY-GREEN, A KEY TRAIT FOR CLIMATE RESILIENCE

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Increasing demand for the climate resilient crops in the global agricultural scenario, stay-green phenotype gained the attention of plant breeders. Crop yield under stress strongly depends on photosynthates provided either through current photosynthesis or through the remobilization of stored carbohydrates from the stem. Stay-green (SG) is the most significant trait, which allows the plants to retain green leaf area for longer time after anthesis than standard genotypes, maintains photosynthetic activity and assimilation process and subsequently increase the crop yield. Cytokinin

accumulation, ABA reduction and impairment in the chlorophyll degradation pathways will leads to stay-green. The C/N balance during source to sink transition can play a vital role in onset of leaf senescence, where high carbon and low nitrogen accelerates the leaf senescence. SG phenotype delayed the remobilization of N from leaves and maintains photosynthetic capacity for longer, sometimes leading to higher grain yield. The SG phenotype also play a vital role in adaptation of crops to challenging environmental condition such as drought and heat stress without compromising yield. Many quantitative trait loci (QTLs) for SG has been identified in various crops. The SG QTLs are found co-localized in the genomic regions of several agronomically important traits. Therefore, selection of SG phenotype with other valuable traits is the efficient strategy for breeding climate resilient crops.

ROLE OF ICT IN AGRIPRENEURSHIP DEVELOPMENT

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Agriculture all over the world is going through a phase of transition. In India, majority of population lives in village and depends on agriculture and allied activities for their livelihood. The traditional approaches of agriculture being adapted, has numerous challenges in terms of production, processing, storage, marketing, profit etc. These challenges are very crucial for the sustainable development of the farming systems and thus can be minimized by using Information and Communication Technologies (ICT) which is an important pillar of agriculture extension. ICT offers an opportunity to introduce new activities, new services and application into rural areas to enhance existing services. In the current scenario, ICT has been recognized as an essential mechanism for delivering information and advice as an input for modern farming (Jones, 1997). Agripreneurship through ICT is seen as emerging field focusing on enhancement of agricultural and rural development through innovative information and communication process. It plays various roles in the growth and development of national economy which increases the income level and employment opportunities in rural as well as urban areas (Bairwa et al., 2012). Effective utilization of ICT has potential to make the rural communities prosperous as it enables the dissemination of requisite information in user friendly form, easy to access, cost-effective ways at the right time which in turn provide a great scope for Agripreneurship.

Keywords: ICT, Agriculture, Entrepreneurship

A LANDSCAPING TO MANAGE STORM WATER – RAINSCAPING

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Rainscaping is a concept of using sustainable landscape design and management practices to redirect, slow, catch and filter storm water runoff. Rainscaping practices can range from simple solutions to more complex engineered systems. Besides rain gardens and bioswales, a landscape that includes shrubs, trees and perennials and mulch, intercept and disperses rain as it falls, and allows more water absorption into the soil and by plants. Furthermore, multiple techniques like planting buffer zones, amended soils, using permeable pavement and rain barrels can be utilized. Subsuming in to the landscape, it provides incredible benefits like soil conservation, reduce or

eliminate potentially harmful storm water runoff solves drainage issues, reduces outdoor water consumption, reduce air pollution, creates wildlife habitat that promotes biodiversity and cuts down on the number of mosquitoes breeding in the area and increases property value with the addition of appropriate landscape choices.

Keywords: Rainscaping, storm water, runoff

INTEGRATED NUTRIENT MANAGEMENT OF POTATO WITH COMPOST MADE THROUGH DIFFERENT BIO-DEGRADATION PROCESSES-A CASE STUDY FROM NADIA DISTRICT, WEST BENGAL, INDIA

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There is no food security without food safety (The Future of Food Safety, PAO, UN). A paradigm shift in practices is required to ensure a sufficient supply of safe food at a global level while at the same time mitigating climate change and minimizing environmental impacts (FAO, WHO, WTO, AU 2019). The relevance, need and importance of safe and sustainable food are no more a point of debate today. Rather it is a matter of compulsion during an era of accelerated climate change and more particularly after the pandemic Covid 19 outbreak. But, to achieve the goal of safe and sustainable food the only realistic option now-a-days lies with the introduction of low input farming system concept i.e organic and integrated agriculture. Keeping in view the present scenario a study was undertaken in Satyapole village, Haringhata block of Nadia district, W.B on integrated nutrient management of potato during rabi 2018 and 2019. The efficacy of different compost, in terms of their quality, easiness of preparation along with yield and economic attributes were accessed for a high nutrient loving crop like potato. High yield with marginal difference was found among all the treatments with integrated management. But, the treatment with 50% of recommended inorganic fertilizer dose (recommended dose N:P:K@200:150:150 kg/ha, 1/3 N, full P and 1/3 K as basal; 1st and 2nd top dressing with 1/3 N and 1/3 K) and vermi-compost @ 5 ton/ha showed the best result. According to B:C ratio treatment with 50% inorganic fertilizer and NOVCOM compost (same dose for any treatment) showed the best result. But in terms of the bio-degradation process with respect to its end product quality, easiness of procedure and cost, composting made through waste decomposer and NOVCOM has better result in comparison with vermi-compost.

Keywords: Integrated Nutrient Management, Composting process, Potato

MOLECULAR CHARACTERISATION OF HOVER (SYRPHID) FLIES IN COLE CROPS ECOSYSTEM IN MID ALTITUDE OF MEGHALAYA

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Significant morphological similarities within or in between species of insects has made reliable taxonomic identification difficult. DNA barcoding has appeared to be a useful tool in resolving the issues related to the identification of taxonomically difficult insect species. The North eastern

region of India is one of the mega biodiversity hotspots in the World and the climatic conditions of the region are highly conducive for reproduction and multiplication of insects. The efforts were undertaken to study the biodiversity of insects and to develop molecular database by developing DNA barcodes of hoverfly as limited information is available on diversity of hover fly in cole crops ecosystem in mid hills of Meghalaya. A total of 5 species belonging to order Diptera viz., *Episyrphusviridaureus*, *Melanostomaorientale*, *Sphaerophoriamacrogaster*, *Eristaliscerealis* and *Macrosyrphusconfrator*) were documented during the year 2014-2015. The collected species were identified by established taxonomic keys, by taxonomists and/or molecular basis. DNA was successfully extracted from multiple specimens of 5 species and molecular assays were also undertaken for presence of *Wolbachia* infection. The *Wolbachia* infected specimens were discarded and not used for further analysis. The DNA barcodes were successfully developed for 5 species by sequencing partial Cytochrome oxidase I (COI) gene of mitochondrial DNA. The molecular identity of the insect species was established through BLAST-n at NCBI. The total nucleotide length of barcodes varied from species to species (501bp, 569bp, 600bp, 657bp & 663bp). All the analysed sequences were submitted to National Centre for Biotechnology Information (NCBI) and Accession numbers were obtained (KT175585, KT175588, KT175592, KT175599 and KT175606). The ITS1 region was also characterized for five species of syrphid flies and significant polymorphism were detected. Evolutionary divergence between five species of syrphid flies ranged from 8.4 to 16.2%. Eight non-synonymous amino acid substitution were detected among five species of syrphid fly. The comprehensive taxonomical and molecular database developed in this study for a total of 5 species observed in cole crop ecosystem could be used as diagnostic guide at both morphological and molecular level.

Keywords: Biodiversity, Cytochrome oxidase I (COI), Polymorphism, Molecular, DNA barcoding

FOOD INSECURITY AMONG TEA PLANTATION WORKERS OF ASSAM DURING COVID-19 CRISIS

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The COVID-19 pandemic has shattered the global health systems, creating rippling effects on every aspect of human life including the food sector. The impact is outrageous among the economically weaker sections, often resulting in severe food insecurities. The tea plantation workers of Assam are one of the most underprivileged communities in the state. Therefore, the present study is aimed at evaluating the impact of pandemic on their food intake.

Objective: The present study is carried to assess food insecurity among tea plantation workers of Assam by evaluating their food consumption and food handling patterns during COVID-19 pandemic.

Method: Data is obtained using a standardized questionnaire via telephonic conversation. Records on food procurement from public distribution system (PDS) are obtained from tea estate welfare officers. Household food insecurity is measured by Household Food Insecurity Access Scale (HFIAS).

Result: The study reveals a high score of food insecurity among the tea plantation workers. Low availability and accessibility to food and other resources has affected their food intake from almost every food group. Poor food handling practices prevail among the workers, which further contribute to the food insecurity by paving way for infections and diseases. Low socio-economic

condition and lack of education and awareness are factors that attribute to this crisis during the pandemic.

Implications: The onset of COVID-19 has affected the economy and food sector, which has drastically reduced food affordability among the tea plantation workers. The need of the hour is to sensitize them about utilising local resources and adopting proper food handling measures to curb the existing food insecurity and sustain the resources for future. It is necessary to bring mitigation steps to eradicate the lack of availability in food and resources at this crucial stage and prevent the deterioration of their health.

Keywords: pandemic, food insecurity, tea plantations workers, food handling, food consumption

CULTURAL, MORPHOLOGICAL AND PATHOGENIC VARIABILITY AMONG THE DIFFERENT ISOLATES OF *Fusarium oxysporum* f. sp. *cicero*

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Chickpea (*Cicer arietinum* L.) is an important pulse crop, which belongs to family *Leguminaceae*, chickpea having $2n=16$ number of chromosomes. Chickpea is native of India and tropical, subtropical and temperate regions. It is ranked 3rd after common bean. Pulses play an important role not only from economical point of view but also due to their nutritional value. Chickpea is valued for their nutritive seeds with high protein content, 25.3-28.9 per cent after dehulling. Carbohydrate 61.5 per cent, fat 4.5 per cent and vitamins 2.44 per cent. Variability among the ten isolates of *Fusarium oxysporum* f. sp. *cicero* (FOC), collected from different locations of Parbhani district in Maharashtra. Ten isolates were studied in respect of cultural, morphological characters and Pathogenic variability. Result of the above study reveals that pathogenic variability has been established by inoculating ten days old seedlings of different cultivars individually with the *Fusarium oxysporum* f. sp. *cicero* isolates. JG 62 exhibited susceptible reactions to FOC isolates with highest percentage of seedling mortality whereas, JG 315 and BCP-160 were exhibited resistant reactions to the FOC isolates with lowest mortality percentage due to wilt varied within the cultivars. Cultural studies of all isolates of *F. oxysporum* f. sp. *cicero* resulted that isolates differ in the growth rate, types of colony, sporulation, and pigmentation on Potato Dextrose Agar is being favorable for luxuriant growth for all the isolates and dry weight of mycelia mat growing them on Potato Dextrose Broth medium. Morphological studies of different isolates of *Fusarium oxysporum* f. sp. *cicero* concluded resulted in the variations in size, septation and formation of chlamydospores.

Keywords : Chickpea (*Cicer arietinum* L.), *Fusarium oxysporum* f. sp. *cicero* (FOC), isolates.

FLOATING GARDENS – NEW APPROACH FOR FOOD SECURITY IN FLOOD PRONE AREAS

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The landscape with colourful diversified floating gardens has a unique aesthetic view on a wide stretch of water and is a delight to the eyes and the mind. Earlier these floating vegetable gardens were used as a low-cost tool to grow food for starving community in monsoon season in countries like Bangladesh where floods occur perpetually. As they provide food security and livelihood to

these floods affected communities. Floating vegetated islands, also known as floating wetland islands, can be broadly defined as emergent vascular plants growing on a buoyant mat of live and dead plant roots and organic matter including decomposing peat. These floating gardens are naturally formed as well as artificially made using different materials based on availability and purpose. This concept of floating gardens was traditionally also found in India since ages. The best examples of them are vegetable gardens of Dal Lake, Kashmir, Floating gardens of Odisha, Floating gardens of Loktak Lake (Manipur) and also in backwaters of Kerala. Apart from using locally available weeds like *Typha* and *Eichornia*, plants like vetiver grass, bamboo sticks, coconut and palmyrah leaves, husk, and shells can be used as low-cost buoyant material. Nowadays many companies are coming up with new techniques and using materials like polyethylene, polyurethane and neoprene materials welded together for construction of rafts which have longer durability. Floating gardens optimizes the opportunity to provide a landscaped habitat for fish and wildlife while cleaning polluted water in the lakes and rivers. Moreover, by using bioengineering techniques we can design and construct floating gardens with natural structural components in combination with vegetation for erosion control, water quality and habitat restoration. Additionally, they enhance the natural beauty of public spaces and artificial water features for greater enjoyment and recreation.

ECONOMIC IMPORTANCE OF INTEGRATED FARMING SYSTEM AMONG TRIBAL COMMUNITIES OF BTAD (ASSAM)

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Agriculture is the mainstay of livelihood for the people of the Bodoland Territorial Autonomous District (BTAD) comprising of Kokrajhar, Chirang, Baksa, Udalguri. Approximately 90% of the population are engaged in farming. Agriculture in this area is the lifeline of both the rural and urban population and constitutes to be a major source of income for livelihood in rural BTAD. Apart from agriculture, the economy of BTAD also depends on other allied activities like livestock and poultry farming, sericulture, fishery, khadi and village industries, tourism *etc.* In the recent past, small tea gardens & rubber plantations also contribute in a big way to the economy in certain locations of BTAD. The livestock farming has been an integral part of traditional life among rural households in BTAD which contribute considerable amount to the economy of rural population in these areas. Almost all the households in the villages are engaged in the livestock farming like piggery, dairy, poultry, duckery, goatery, fishery *etc.* By and large, BTAD is characterized by fragility, marginality, inaccessibility, culturally heterogeneity, ethnicity, however it is endowed with a rich repository of biological diversity, valuable genetic resources of agricultural & horticultural crops and a plethora of natural resources. The production system is characterized by low cropping intensity, subsistence level and mono cropping. Therefore, integrated farming system (IFS) approach is not only a reliable way of obtaining fairly high productivity with considerable scope for resource recycling and ecological soundness leading to secure household food and nutritional security. Location specific farming components (rice-fish-vegetable, poultry-fish-vegetable, pig-fish-vegetable, fish-vegetable, fish-duck-vegetable, fish-rabbit *etc.*) are required to be carefully integrated to harness complementarities between enterprises to achieve optimum productivity per unit area, ensuring food and nutritional security and getting higher returns and bio-resource flow within the system.

Keywords: IFS, livelihood, nutritional security, BTAD.

PHYSIOLOGY OF DROUGHT STRESS IN HIGHER PLANTS WITH REFERENCE TO VEGETABLE CROPS

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Water deficit is a major environmental factor restricting growth, development and productivity of vegetable crops in arid and semi-arid regions more than any other single environmental factor. Water limitations can influence many physiological processes in plant, altering production of vegetables. Vegetables are basically succulent in nature and generally consist of more than 90 per cent of water. Vegetable crops typically use more water than agronomic crops. Thus moisture stress, mostly at critical period of growth may drastically reduce productivity and quality of vegetables. Water stress induces excessive generation of reactive oxygen species (ROS) including superoxide anion (O_2^-), hydrogen peroxide (H_2O_2) and hydroxyl radical (OH^\cdot), which could cause deterioration of membrane proteins, lipids and nucleic acids, leading to increased membrane leakage of solutes causing cellular damage in plants resulting in lower yield. However, tolerant species adapt themselves by displaying a range of morphological, physiological and biochemical mechanisms to withstand moisture stress. Hence, the various morphological, physiological and biochemical mechanisms involved in drought tolerance are considered to be essential tools for selection of drought tolerance varieties of vegetable crops. The yield of vegetable crops under water deficit can also be maintained by various crop management practices as well as by different drought management advisories.

Keywords: Drought Stress, Vegetables, Critical Period, Tolerant mechanisms, Symptoms, Management

DIVERSITY OF INSECT POLLINATORS ON RAPESEED CROP IN THENZAWL, MIZORAM

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Rapeseeds are one of the important winter vegetables of Mizoram which are grown after the harvest of Jhum Rice in the region. The flowers of rapeseed are frequently visited by different species of pollinators from morning till evening hours. Therefore a study was made to study the diversity of pollinators of rapeseed in the region. Survey on insect pollinators of rapeseed was conducted at Thenzawl area during 2019-20. About twelve species of insect pollinators belonging to five families under three orders viz., Hymenoptera, Diptera and Lepidoptera were observed pollinating the rapeseed flowers under natural condition, and their foraging activity was highest during 0900-1100 hrs. *Apis cerana*, *Tetragonulasp.* (red abdomen), *Tetragonulasp.* (black abdomen), *Lepidotrigona arcifera*, *Bombus sp.*, *Nomia sp.*, *Erisyrphus balteatus*, *Allograpta javana*, *Eristalinus sp.*, *Musca domestica*, *Pieris canidia* and *Pieris napi* were recorded. Among all the species, *Apis cerana* was found to be dominant forager with the relative abundance of 23.00 per cent followed by *Tetragonulasp.* (black abdomen), *Lepidotrigona arcifera* and *Tetragonulasp.* (red

abdomen) with the relative abundance of 16.43, 14.55 and 14.08 per cent respectively. The lowest was observed in *Pieris napi* with the relative abundance of 0.94 per cent. Out of the twelve species of pollinators observed the stingless bee *Tetragonulasp.* (red abdomen), *Tetragonulasp.* (black abdomen) and *Lepidotrigona arcifer* were reporting for the first time pollinating rapeseed flowers in Thenzawl area of Mizoram.

Keywords: Rapeseeds, pollinators, diversity, Thenzawl, Mizoram

IMPROVING NUTRIENT USE EFFICIENCY FOR SUSTAINABLE AGRICULTURE YUMNAM SANATOMBI DEVI¹, SAPAMRAJESHKUMAR SINGH², ANJU KEISAM¹,

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In the last five decades, crop production have been improved by greater use of fertilizer. In modern intensive agriculture fertilizers play vital components and continued improvements in plant nutrition will be needed to meet the increasing demands for food and fiber from a growing world population. However, a significant portion of nutrients applied to the soil through fertilizer amendment is not taken up the plants and is lost through leaching, volatilization, nitrification or other means. Such a loss increases the cost of fertilizer, degrades soil and pollutes the environment. Widespread of nutrient deficiency and deteriorating soil health are causes of low nutrient use efficiency, productivity and profitability. To alleviate these problems, enhanced efficiency fertilizer are used these can be achieved by adoption of site-specific balance and integrated nutrient management involving major, secondary and micro nutrients, organic manures, biofertilizer and amendments, also utilizing all indigenously available nutrient sources to reduce dependence on imports. In this review, we focused on discussing the significance of NUE and how NUE can be enhanced.

COMPARISON OF NUTRIENT COMPOSITION, ANTIOXIDANT ACTIVITY AND COMMON PHYTOCHEMICALS OF SELECTED BARI MANGO VARIETIES

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The present study sought to explore the nutritional composition, minerals, bioactive phytochemicals and antioxidant activity of the selected BARI mango varieties. The total phenolic (TPH), vitamin C, total carotene, β -carotene content and antioxidant activity of the mangos were determined by 1,1-diphenyl-2-picryl hydrazyl (DPPH) scavenging, and reducing power assays (RPA). Phenolic compounds were assessed using high-performance liquid chromatography coupled with a photodiode array detector and auto sampler. Results revealed that average edible and non-edible portion of the BARI mango-4 were 208.67 g and 39.00 g respectively whereas the BARI mango-6 was 189.00 g and 36.67 g respectively. Moisture, TSS, pH, total acidity, reducing, total sugar and energy of the BARI mango-4 were 76.54 %, 17.10°B, 4.23, 0.49 %, 3.90 %, 11.20 % and 4028.06 cal/g respectively whereas the BARI mango-4 remained 75.27 %, 20.20°B, 5.01, 0.50%, 4.54 %, 4028.06 cal/g respectively.

13.46 % and 3950.27 cal/g respectively. Phytochemicals especially TPH, ascorbic acid, total flavonoid (TF), total carotenoid (TC), β -carotene and total anthocyanin content (TAC) of the BARI mango-4 were 20.53 mg GAE/g, 39.98 mg/100 g, 3.14 mg QE/g, 76.38 mg/100 g, 28.17 μ g/100 g and 1.67 mg/100 respectively whereas the BARI mango-6 contained 20.67 mg GAE/g, 27.05 mg/100g, 2.87 mg QE/g, 81.33 mg/100 g, 65.84 μ g/100 g and 11.69 mg/100 g respectively. In case of antioxidant activities total antioxidant capacity, DPPH radical scavenging activity, reducing power capacity (RPC), metal chelating capacity (MCC), Nitric oxide (NO) free radical scavenging activity and IC₅₀ of the BARI mango-4 were 229.00 μ g of ascorbic acid/mg of extract, 96.84 %, 12.20 μ g/mL, 157.36 %, 61.74 μ g/mL and 0.59 μ g/mL respectively whereas the BARI mango-6 contained 309.00 μ g of ascorbic acid/mg of extract, 94.73 %, 9.71 μ g/mL, 132.89 %, 72.62 μ g/mL and 0.71 μ g/mL respectively. The results indicate that BARI mango-6 exhibited rich source of TPH, TC, β -carotene, TA, TAC and NO free radical scavenging activity than BARI mango-4. Moreover, BARI mango-4 and BARI mango-6 extract had a great potential to fight free radical chain reactions and for usage in therapeutic applications.

Keywords: Mangoes; nutrients; bioactive compounds; antioxidants

LIQUID ORGANIC MANURES IN SOIL FERTILITY IMPROVEMENT AND CROP PRODUCTION

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Continuous and indiscriminate use of chemical fertilizers has resulted in decline in soil organic matter and decreased nutrient use efficiency. To overcome the potential threats of chemical fertilizers manures acts as an indispensable factor in rejuvenating soil fertility and revamping crop productivity. Manures are plant or animal based organic material which is known to stimulate plant growth, improve quality of the produce and have beneficial effects on the physical and chemical properties of the soil. Addition of manure and crop residues to soil is a strategy to increase soil matter which imparts substantially in soil health and its potentiality and sustainability to function as a living entity. Liquid organic manures are valuable source of nutrient and organic matter in crop production however they are less efficient when compared with chemical fertilizers. Liquid manure has been found to be best replacement in overcoming short-term nutrient shortages. It has been projected that plants uptake nutrient 20 times faster through their leaves than through soil. Liquid manure also acts as irrigation, when applied on the soil, is generally applied through foliar spray, land surface spreading and through subsurface injection. Application of liquid organic manures such as panchgavya, liquid fish manure, liquid bone meal, water hyacinth extract, cow urine, vermiwash, cow urine, seaweed extracts etc., has shown positive results on the population of beneficial microflora such as bacteria, fungi and actinomycetes which is able in maintaining sustainable soil health for agricultural productivity. Bio-liquid contains good amount of vitamins, essential amino acid, macro and a vast array of trace elements in natural form which is enumerated with growth promoting substances, anti-fungal and anti-microbial properties which helps in stimulating plant growth, overall soil health and effective against certain kind of insect pests. Studies has reported that addition of liquid manure can increase corn yield by 7-10%, viz. *Kappaphycusalvarezii* resulted

in 30.11% higher seed yield in maize, 13.16% increase in wheat yield etc. Freshly made liquid manure is diluted with water before spraying depending on the concentration of the liquid. Before foliar or soil application one part of liquid manure is mixed with 6-8 parts of water, which varies accordingly with type of manure and its concentration. Addition of nutrient enriched liquid bio-manures not only helps in feeding soil but also to plants which results in obtaining higher and superior quality produce which is necessary for an agro-ecosystem in longer term sustainability.

Keywords: anti-microbial, crop productivity, liquid manure, nutrient, quality, soil health.

EFFECT OF DIFFERENT LEVELS OF SALINE-SODIC IRRIGATION WATER ON AVAILABLE MICRO NUTRIENT CONTENT AFTER HARVEST OF WHEAT CROP

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A pot experiment was conducted during the *rabi* season 2017-2018 at Net House, Department of Agricultural Chemistry and Soil Science, Junagadh Agricultural University in Junagadh, Gujarat. The experiment comprising of each four levels of saline (2, 4, 6 and 8 dS m⁻¹) and sodic (5.0, 10.0, 15.0 and 20.0 SAR) irrigation water in a completely randomized design with three replication, were tested for available micronutrients (Fe, Zn, Mn and Cu) after harvest of the crop. Among the DTPA extractable micronutrients, the experimental soil was found medium for Fe (5.91 mg kg⁻¹), Zn (0.75 mg kg⁻¹) and Mn (8.72 mg kg⁻¹), but was high with respect to Cu (0.62 mg kg⁻¹). The soil analysis data revealed that the soil available micronutrient content after harvest of the crop was significant with different levels of saline irrigation water and the highest available Fe, Zn, Mn and Cu content were 5.820, 0.709, 8.495 and 0.591 ppm was found with EC- 2.0 dS m⁻¹ and the lowest available Fe, Zn, Mn and Cu content were 5.430, 0.618, 8.011 and 0.526 ppm was noticed with EC-8.0 dS m⁻¹ saline irrigation water level. And it was found significant with different levels of sodicity in irrigation water. The highest available Fe, Zn, Mn and Cu content were 5.731, 0.690, 8.387 and 0.588 ppm observed with SAR-5.0 and the lowest of 5.576, 0.636, 8.610 and 0.523 ppm respectively, were noticed with SAR-20.0 sodic irrigation water level. The interaction effect of salinity and sodicity levels of irrigation water found non-significant on available Fe, Mn and Cu, whereas it was found significant with available Zn.

Keywords: Saline- sodic irrigation water, Electrical conductivity, SAR and DTPA

HONEYBEES FORAGING ACTIVITY STUDY ON PROMISING BEEFLORA BOTTLEBRUSH (*Callistemon lanceolatus*)

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Insects are the major pollinators and pollinate around 80 per cent of the commercial crops for which sustainability and continuity of the ecosystem is maintained. The main group of insect pollinators is the bees, wasps, butterflies, moths, flies and beetles. However, besides honeybees, the frequency of insect visitors is very less. The number of flowers visited by honeybees per minute is more as compared to other pollinators. Notably, honeybees act as the main pollinator insect of many

cultivated crops as well as plantation crops and observed globally for its pollination potential. Promising beeflora, *Callistemon lanceolatus* belongs to the family Myrtaceae and different *Callistemon* spp. are widely planted throughout the country as an avenue tree or ornamental tree in various land use systems. It is a small tree ranges from 6 to 8 m tall while the inflorescence bears number of individual flowers blooming throughout the year. The flowers are crimson red with dark red anthers alluring to nectar feeding birds and insects. Although *Callistemon* plant is included in the honeybee floral calendar, but there is meager information on the foraging activity of honeybees and other insects. The present investigation was carried out to find the foraging activity of different honeybee species on fully bloom bottlebrush plant during August month in South Gujarat condition. For this fully bloomed trees in NAU campus were selected to study the different honeybee foraging activity. Total five honeybee species such as *Apis cerana*, *A. mellifera*, *A. dorsata*, *A. florea* and *Tetragonula* spp. were observed in the process of foraging activity study. *A. florea* was found the main pollinator of bottlebrush as compared to other honeybees. It was noted maximum frequency of visit (45.46/ min) by *A. florea* followed by *A. dorsata* (31.17/ min) and maximum frequency of visitation was recorded during the afternoon period. The visitation of *A. cerana* and *Tetragonula* spp. on bottlebrush flowers were found highly influenced by weather situation, whereas reverse situation was noticed for *A. florea*.

Keywords: Beeflora, Bottlebrush, Foraging activity, Honeybees

UTILIZATION OF WILD RELATIVES FOR RESISTANCE BREEDING AGAINST BIOTIC STRESS IN TOMATO

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Tomato (*Solanum lycopersicum*) plant hosts more than 200 species of pest and pathogens. As a consequence of inbreeding during tomato domestication, the genetic diversity in cultivated tomato is very narrow (<5%). Breeders have exploited wild relatives for resistance to diseases for a century and over 42 resistance genes have been derived from *Solanum peruvianum*, *Solanum chilense*, *Solanum pennellii* and several other wild relatives and 20 of them bred into horticultural tomatoes. Most of the resistance governed by R-gene mediated resistance, quantitative resistance: longer lasting, 'durable'?. Most wild tomatoes have very small populations, making them vulnerable to extinction. Therefore, to discover and maintain species diversity in bio diverse region is extremely important. However, it is virtually impossible to exploit all individual wild accessions by generating genetic libraries of ILs, considering 75 000 *Solanum* accessions conserved in gene banks around the world. Utilisation of wild relatives has been expedited recently by application of various molecular genetic methodologies. With all the genomics expression and metabolite databases, breeder will select the best combinations of genotypes and design programmes to combine traits in new cultivars in a 'breeding by design' process.

Keywords: Tomato, wild accessions, Crop improvement

EFFECT OF RHIZOBIUM AND PHOSPHORUS ON GROWTH AND YIELD OF MUNGBEAN (*Vigna radiata* L.)

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Mung bean (*Vigna radiata* L), commonly known as green gram, is an important pulse crop of India. It has the ability to fix atmospheric nitrogen (N) through *Rhizobium* species, living in nodules on its roots. The rate of nodulation is very low in most of the mung bean growing area in India. Therefore, to study the influence of phosphorus (P) fertilization and *Rhizobium* inoculation on the nodulation, growth and yield of mung bean (*Vigna radiata*), a pot experiment was conducted in net house, during spring season of 2017 at ICAR-National Bureau of Plant Genetic Resources, New Delhi. Seeds of mung bean variety *PusaBaishakhi* were inoculated with *Rhizobium* and sown in pots containing 15 kg soil. Phosphorus was applied at 1.5, 2.5 and 3.5 g per 15 kg soil in each pot alone and along with inoculation of *Rhizobium phaseoli* except in control pot. The source of P was single super phosphate that was mixed with soil before filling the pots. Recommended doses of N and K fertilizers were applied by using urea of 40 g per 15 kg soil and muriate of potash of 75 g per 15 kg soil for the sowing, respectively. The experiment was laid out in factorial completely randomized designs with three replications. The pots were irrigated with fresh water, using sprinkler bucket in seven days interval. Plant height was recorded after 15 days of germination and at the time of maturity. After harvesting, length of roots, number of nodules per plant, number of pods per plant, number of grains per pod, weight of grains per plant and 1000-grain weight were recorded. The data collected for various characteristics were subjected to the analysis of variance. Results indicate that combined use of P and inoculants enhanced the number of nodules per plant. The maximum nodules, 8.70 per plant, were recorded where 3.5 g P along with *Rhizobium* inoculation was applied. Phosphorus application along with *Rhizobium* inoculation increased the plant height significantly (13.2%) over control. Maximum increase in plant height at maturity, total number of pods and number of grains per pod were also recorded where 3.5 g of phosphorus along with *Rhizobium* inoculation was applied. Phosphorus along with *Rhizobium* inoculation application increased plant height, total number of pods, number of grains per pod, and 1000- grain weight significantly. Maximum increase was noted where 150% of the recommended phosphorus along with *Rhizobium* inoculation was applied but it was statistically at par with the results obtained by applying 100% of the recommended phosphorus along with *Rhizobium* inoculation. Therefore, 100% of the recommended phosphorus along with *Rhizobium* inoculation is the best treatment in the experiment.

Keywords: Mungbean, growth, nodulation, phosphorus, inoculation

EFFECT OF PLANT DENSITY ON CUT FLOWER PRODUCTION OF CALENDULA

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An experiment was carried out at Farm no. 16 of Horticulture Section, College of Agriculture, Nagpur (M.S.) India during the year 2014-15 to study the response of calendula to plant density for cut flower production with seven treatments of spacing *viz.*, 30x30 cm, 30x20 cm, 30x10 cm, 20x20 cm, 20x10 cm, 15x15 cm and 15x10 cm in randomized block design. The results revealed that, the wider spacing of 30x30 cm recorded significantly maximum leaves plant⁻¹, spread of plant, longevity of intact flower, cut flower yield plant⁻¹, diameter and weight of flower and vase life of flower, whereas, closer spacing of 15x10 cm recorded significantly longest stalk length of cut flower and earliest 50 per cent flowering. However, the spacing of 30x10 cm noted the highest yield of cut flower in calendula and it was found beneficial with the highest C:B ratio for cut flower production. The next best treatment in respect of cut flower yield and economics was 15x10 cm.

PERFORMANCE OF ANNUAL CHRYSANTHEMUM GENOTYPES AND THEIR RESPONSE TO DIFFERENT LEVELS OF NITROGEN

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A field experiment was conducted to study the performance of various annual chrysanthemum genotypes under Nagpur conditions and their response to different levels of nitrogen at College of Agriculture, Nagpur during winter season of the year 2015 with sixteen treatment combinations in Factorial Randomised Block Design. The treatments comprised of four different genotypes of annual chrysanthemum *viz.*, NAC-04, NAC-07, NAC-10 and NAC-12 and four levels of nitrogen *viz.*, 0 kg N ha⁻¹ (control), 50 kg N ha⁻¹, 100 kg N ha⁻¹ and 150 kg N ha⁻¹. The results revealed that, significantly highest plant height and disc diameter of flower were recorded with the genotype NAC-12, whereas, significantly maximum branches and flowers plant⁻¹ were noted with NAC-10. However, the genotype NAC-07 flowered significantly earlier and recorded maximum flowering span, flower yield ha⁻¹, flower diameter and number of petals flower⁻¹ and whorls flower⁻¹. In respect of nitrogen levels, the highest dose of nitrogen (150 kg N ha⁻¹) was found significantly superior over all other levels except 100 kg N ha⁻¹ in respect of plant height, branches plant⁻¹, flowering span, flower yield ha⁻¹, flower diameter and number of petals flower⁻¹ and whorls flower⁻¹. Interaction effect of genotypes of annual chrysanthemum and various nitrogen levels on all the characters under study was found non-significant except days for initiation of first flower bud. The earliest first flower bud initiation was recorded with the treatment combination of V₂N₁ i.e. genotype NAC-07 with 0 kg N ha⁻¹.

STUDIES ON GENETIC VARIABILITY, HERITABILITY, GENETIC ADVANCE AND TRAIT ASSOCIATION IN INDIAN MUSTARD (*Brassica juncea*) CZERN AND COSS

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The present investigation was planned to estimate variances between family and within family, to estimate genetic parameters and to identify superior mutants for further utilization at experimental farm of Agricultural Botany Section, College of Agriculture Nagpur during *rabi* 2017 in M_3 generation. In *rabi* 2016, 71 mutants were identified along with one check and in *rabi* 2017, these 71 mutants along with one check (PM-21) were evaluated in M_3 generation in Randomized Block Design with two replications. Significant differences were observed for all seven characters were considered. Based on genetic parameter analysis 161 mutants were selected along with GCV, PCV, heritability and genetic advance considering number of siliqua, 1000 seed weight and yield plant⁻¹. Thus, 161 mutants were selected from PM-21 variety treated with different doses of sodium azide ($T_1 = 0.03\%$ SA, $T_2 = 0.06\%$ SA and $T_3 = 0.09\%$ SA). All these mutants will be forwarded to M_4 generation in progeny rows for one or more generation so that homozygosity will be attained and the superior genotypes can be selected for forwarding to yield trials in further generation.

Keywords: *Brassicajuncea, mutation, heritability, genetic variability, sodium azide*

FUTURE OF ORGANIC FARMING: BENEFITS & CHALLENGES

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Organic farming depends on ecologically balanced agricultural principles which are crop rotation, cultural practices, organic waste, biological pest control, green manure, mineral, rock additives etc. Its demand is increasing greatly. Its benefits are: Organic food is safe, clean and more nutritious. Organic farming features practices which advances ecological balance, cycle resources and conserve biodiversity. It helps in combatting climate change and reduces dependency on fertilizers, pesticides, weedicides and also consumes less energy. Animals are also reared organically. Government is launching various schemes, courses to promote it and many conferences are taking place to improve it. Challenges include lengthy procedures to get certification for adopting this practice. Organic inputs are limited in supply like bio-fertilizers, bio-pesticides etc. It also requires different equipments, investment, time and patience. It needs different storage facility and transportation. More organic specialists and bodies are needed to raise awareness about it and to solve its problems. In future, it seems great boom and prominence in organic farming is what awaits for us.

Keywords: Organic farming, bio-fertilizer, biodiversity, ecological balance

CORONAVIRUS DISEASE EFFECT ON ENVIRONMENT SAMIYA MAQSOOD

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The coronavirus COVID-19 pandemic is the determining worldwide health catastrophe at this juncture. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causal agent of this disease. Its positive impact on the environment include significant increase in air quality, sharp drop in level of greenhouse gases, visibility of mountain peaks from adjoining areas, improvement in water quality of rivers and wildlife has also responded to the change. Animals can be seen wandering around. Negative consequences include- farmers are not able to access their fields, ecosystems are not getting maintained. Illegal deforestation, fishing and wildlife hunting has risen, problem of recycling of waste, generation of organic waste is occurring. Ecotourism, alternate energy sources, economy are affected and unemployment is increasing. Environmental diplomacy efforts by the governments are also disrupted. Covid-19 economic rescue plans should be green. Since climate change is a threat, so changes should be done for low carbon future for which innovation in technology and better policies are needed.

Keywords: COVID-19, environment, air and water quality, wildlife, ecosystem

STATUS OF SEED-BORNE FUNGI IN SOME INDIGENOUS MILLET GERMPLASM IN INDIA

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Millets are small seeded cereal crops, known for their nutritional values and ability to grow with little inputs. These are climate resilient crops and constitute an important staple in the semiarid tropics and ensure food and nutritional security. These are tolerant to abiotic and biotic stress although some diseases pose serious threat on millets production. As millets plant genetic resources are very important for nutritional security, they are being conserved in the National Gene Bank at ICAR-NBPGR, New Delhi. During seed health testing (2015-2018), many fungal pathogens were detected in indigenous millets germplasm and identified on the basis of morphological characteristics. The identified fungi included *Alternaria padwickii*, *Bipolaris bicolor*, *B. cynodontis*, *B. halodes*, *B. hawaiiensis*, *B. longirostrata*, *B. micropus*, *B. oryzae*, *B. sacchari*, *B. setaria*, *B. sorghicola*, *B. sorokiniana*, *B. spicifera*, *B. tetramera*, *Cephalosporium maydis*, *Claviceps fusiformis*, *Curvularialunata*, *C. pallens*, *Exserohilumrostratum*, *Fasariumsolani*, *F. equiseti*, *F. oxysporum*, *F. poae*, *F. semitectum*, *F. solani*, *F. verticillioides*, *Gloecercosporasorghii*, *Melanosporazamiaae*, *Myrothecium verrucaria*, *Phomaexigua*, *P. sorghina*, *Pyriculariagresea*, *Rhizoctonia solani*, *Sphacelothecasorghii*, *Tolyposporiumpenicillariae*, *Ustilagoeleusinis* and *Verticilliumalbo-atrum* on seeds of sorghum, pearl millet, foxtail millet, barnyard millet, finger millet, etc. Among millets *Sorghum bicolor*, *Pennisetum glaucum* and *Eleusine coracana* were the most affected crops by different fungi. The infection level in seed varied ranging from 10 to 100 per cent. As a result of fungal infection, seed germination was also affected and range varied from 10-100 per cent. If such infected seeds are conserved and/or distributed for either research purpose or their commercial use, they may act as a source of inoculum dissemination and hamper the cultivation of millets leading to qualitative and quantitative losses. Therefore, ensuring seed health/quality is very important in conserving disease-free material and/or supplying seed for their commercial use with minimum risk of spreading disease in the country.

RESPONSE OF SOIL FERTILITY AND QUALITY ON DEFORESTATION

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Deforestation means the conversion of forest to agriculture, pasture, water reservoirs, urban areas and other land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold. Deforestation is caused due to hurricanes, natural fires, pests, agricultural expansion, cattle ranching, logging, unpriced forest goods and services, concentration of land ownership, weak or non-existent ownership, population growth and density and economic growth. A pattern of decreased bulk density and increase porosity values was observed for the samples of forest sites compared to those of the adjoining cultivated soils. The soils under cultivation showed higher clay, silt and lower sand fraction's than that of soil under forest. The rainfall runoff experiments indicate that runoff content of the garden and cultivated land was lower than the natural forest soils. Soil erosion was higher in cultivated soil as compare with forest soils. Cultivated lands have higher pH values than the forest soils. The forest soils manifested a considerable decrease in the values of C:N ratio with the adjoining cultivated soils. The amount of CEC drops due to conversion of forest land to cropland. Soil organic C, POC and MOAC losses under longer periods of cropping are probably due to decreases in the above ground net primary production (ANPP), increases in the mineralization rate due to higher temperature and aeration and wind erosion. The microbial community *i.e.*, the fungal and bacterial population was also significantly lower in both surfaces (0-10 cm and 10-20 cm) of hill positions in the deforested land compared to natural forest. Microbial/biochemical indicators showed perceptible deterioration in the topsoil due to deforestation. In general, deforestation provides some advantages to human but it deteriorates soil fertility and quality significantly. So we need to stop deforestation and search for new way for our mankind.

Keywords: Deforestation, soil pH, soil organic carbon and soil microbes.

ROLE OF NANOTECHNOLOGY IN AGRICULTURE

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The word "nano" comes from the Greek for "dwarf". The design, characterization, production and application of structures, devices and systems by controlling shape and size at the nanoscale British Standards Institution (BSI, 2005). Bionanotechnology, and nanobiology are terms that refer to the intersection of nanotechnology and biology. Biochemical principles that are used to understand the material properties of biological systems are central in bionanotechnology such as target delivery of pesticides, hormones and fertilizers in agriculture. The impact of bionanoscience, achieved through structural and mechanistic analyses of biological processes at nanoscale, is their translation into synthetic and technological applications through nanotechnology. In agriculture industry, engineered nanoparticles have been serving as nano carriers, containing herbicides, chemicals, or

genes, which target particular plant parts to release their content. Previously nanocapsules containing herbicides have been reported to effectively penetrate through cuticles and tissues, allowing the slow and constant release of the active substances. Likewise, nano-encapsulated slow release of fertilizers has also become a trend to save fertilizer consumption and to minimize environmental pollution through precision farming. These are only a few examples from numerous research works which might open up exciting opportunities for nanobiotechnology application in agriculture. Also, application of this kind of engineered nanoparticles to plants should be considered the level of amicability before it is employed in agriculture practices. Based on a thorough literature, it was understood that there is only limited authentic information available to explain the biological consequence of engineered nanoparticles on treated plants. Certain reports underline the phytotoxicity of various origin of engineered nanoparticles to the plant caused by the subject of concentrations and sizes. At the same time, however, an equal number of studies were reported with a positive outcome of nanoparticles, which facilitate growth promoting nature to treat plant. In particular, compared to other nanoparticles, silver and gold nanoparticles based applications elicited beneficial results on various plant species with less and/or no toxicity. Silver nanoparticles (AgNPs) treated leaves of Asparagus showed the increased content of ascorbate and chlorophyll. Similarly, AgNPs-treated common bean and corn has increased shoot and root length, leaf surface area, chlorophyll, carbohydrate and protein contents reported earlier. The gold nanoparticle has been used to induce growth and seed yield in *Brassica juncea*.

Keywords: Nano particles, agriculture, applications, phytotoxicity, beneficial results

EFFECT OF CHEMICALS ON *Galleria mellonella* INFECTIVITY OF ENTOMOPATHOGENIC NEMATODE, *HETERORHABITIS INDICA* (POINAR, 1992)

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Entomopathogenic nematodes (*Heterorhabditis*, *Steinernematids*) are used to control many agricultural pests such as *Helicoverpa armigera*, *Spodoptera litura*, *Agrotis epsilon* etc. An *in-vitro* experiment was conducted to identify the efficacy of entomopathogenic nematodes on chemical stressed *Galleria mellonella* larvae. Different chemicals *viz.*, poly ethylene glycol (PEG 2%), magnesium sulphate (MgSO₄-1.75mM) and manganese sulphate (MnSO₄-0.65 mM) were used as chemical stressors. The final instar larvae (5 No's) were treated with the above said chemical suspensions. After chemical exposure, the juveniles of *H. indica* were inoculated with 10-infective juveniles (IJs) / larvae and incubated for 3 days at 20° C. The IJs were extracted using modified white trap method. The results revealed that exposure of *G.mellonella* final instar larvae to PEG4% for 10 minutes increased the infectivity of *Heterorhabditis indica* (61.3% increases over control). Even though there was an increase in the number of infected larvae, the juvenile emergence was completely stopped by chemical treatments. In control 3316.7 infective juveniles were emerged out from the infected larvae.

Keywords: *Heterorhabditis indica*, chemical stress and *Galleria mellonella*

**eNAM - AN EASY APPROACH FOR AGRICULTURAL MARKETING THROUGH
ONLINE PLATFORM IN INDIA DURING COVID-19 PANDEMIC**

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During this period of COVID-19, the main risk involved in human to human transmission during product handling from close contact with infected producer and customer. Many intermediaries vanished due to restrictions on movement, shutdown of markets, and non-availability of logistic support i.e. men and machines; consumers are also locked up in the homes due to health consciousness. At this situation online platforms like eNAM (National Agriculture Market) can facilitate farmers, traders and buyers with online trading in commodities. It was launched by the Ministry of Agriculture, Government of India and managed by Small Farmers' Agribusiness Consortium (SFAC) with the technology provider, NFCL's IKisan division. eNAM is an online trading platform for agricultural commodities in India, available in 8 languages, farmers can opt to trade directly on their own through the mobile app, computer or through registered commission agents. This marketplace allows the farmers to bypass intermediaries, optimizing the supply chain and ensuring traceability to create value for all stakeholders. This e-market is helping in better price discovery and smooth marketing of their produce. Over 90 commodities including staple food grains, vegetables and fruits are currently listed in its list of commodities available for trade. In this market the crops are weighed immediately and the stock is lifted on the same day. The e-market is helping traders and exporters in procuring quality products in bulk, at one place and ensures transparent financial transactions. The payment can be done through RTGS/NEFT, debit card, internet banking, UPI and BHIM. eNAM is linked with 785 markets (APMCs) and 2 union territories, with over 45 lakh farmer membership in 17 states. Recently, the government is fast tracking the integration of eNAM with Farmer Producer Organizations (FPOs) and warehouses, which have been declared as market yards, to provide end-to-end connectivity for farmers. It will then connect these FPOs and warehouses with the transport aggregator mobile App Kisan Rath for seamless supply linkages to intra-state and inter-state buyers. Integration of eNAM and Kisan Rath with FPOs and warehouses will enable farmers to sell and transport their produce anywhere in the country where they get better prices. Since more than 1000 mandis across the country are already on eNAM platform, the government has planned to create 1500 new FPOs in this year and 10,000 FPOs in next five years which will be fully integrated with eNAM. By the use of eNAM farmers, traders, buyers, processors and exporters can get benefit through e-marketing by reducing the intermediation cost. It can increase the number of traders and the competition among them increases which translates into stable prices and availability to the consumers. eNAM can give a new direction and opportunity to agricultural marketing system, and fulfill the supply and demand of agricultural product. eNAM is a easy, time saving and cost effective approach which can boost the Indian economy and can give a secure life to the ever increasing population during this period of COVID-19 pandemic.

Keywords: eNAM, e-Market, Agricultural Marketing, COVID-19

RESPONSES OF SOIL MICROBIAL COMMUNITY BIOMASS AND COMPOSITION FOLLOWING LAND-USE CHANGES IN THE SOUTHERN WESTERN GHATS REGION OF INDIA

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The Western Ghats, one of the 8 hottest hotspots of biodiversity, with exceptional endemic flora and fauna has been facing immense land-use land cover changes over the past four decades. Here, we evaluated the alterations in the soil microbial community biomass and composition upon conversion of prime forests into home gardens, teak, rubber, and acacia plantations. The phospholipid fatty acid (PLFA) analysis, an innovative approach compared to the conventional plating technique, was used to measure the soil microbial community structure of the different land-uses. We also investigated the baseline physico-chemical characteristics of the different land-uses in the study area. The results of the study indicated that the biomass of the total microbial community, gram-negative bacteria, gram-positive bacteria, arbuscular mycorrhizal fungi (AMF), fungi, eukaryotes, and actinomycetes, varied significantly ($p < 0.05$) among the different land-use types. The ratio of fungal PLFAs to bacterial PLFAs was found to be highest in the soil's of natural forest and least in the intensely managed rubber plantations. The total microbial biomass content was found to be very strongly correlated ($p < 0.01$) to the total nitrogen content of the soil. Correlation analysis also revealed soil temperature and organic carbon content to show a strong negative and positive correlation, respectively to the biomass of different microbial groups. Conversion of forest to plantations and home gardens significantly deteriorated the soil microbial biomass and composition. The study concludes accepting the strong influence land-use changes have on the soil microbial community structure and biomass.

Keywords: Western Ghats; soil microbial community; phospholipid fatty acids; land-use changes; carbon; nitrogen; bulk density.

EXPRESSION OF GNAI2 AND DNMT1 IN HMC BUFFALO EMBRYOS DERIVED FROM FRESH AND FROZEN DONOR FIBROBLAST

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Handmade cloning (HMC), a zona free somatic cell nuclear transfer technique, has been applied for the production of cloned embryos and offspring in many livestock species. The main purpose of the experiment was to compare the efficiency of two cell types, namely fresh and frozen fibroblast as donor cells for somatic cell nuclear transfer by HMC in buffalo and expression of two genes. Cultured ear pinna fibroblasts from new born Murrah buffalo calf were harvested and growth of cells at 80-90% confluence at passage 8 were used. The credentials of two types of donor cells, fresh and frozen fibroblast cells, as nuclear donors were explored. There were non-significant ($P > 0.05$) differences in the cleavage rates of the embryos produced from the fresh and frozen

fibroblast cells but significant ($P < 0.05$) differences were seen in the blastocyst formation rates of the embryos derived from fresh and frozen fibroblasts (Table 3). Two genes were analyzed by RT-PCR in the cloned HMC embryos. Amplicons of GAPDH, GNAI2 and DNMT1 with expected lengths of 133bp, 156bp and 100bp respectively, were detected by RT-PCR analysis from embryos derived from fresh and frozen fibroblasts. The relative expression profiles of the 2 candidate genes (GNAI2 and DNMT1) in embryos derived from between from fresh and frozen cells were analyzed by quantitative real-time PCR. There were non-significant ($P > 0.05$) differences in the mRNA transcripts of the genes observed in the embryos derived from fresh and frozen fibroblast cell. Frozen cells can be another source of nuclear transfer

Donor cell type	No. of HMC embryos cultured	Cleaved embryos n (%)	Blastocysts n (%)
Fresh fibroblast	33	23 (69.8±7.8) ^a	06 (24.6 ± 4.1) ^a
Frozen fibroblast	30	18 (61.0±13.1) ^a	04 (12.7 ± 6.5) ^b

n= number of embryos, Values quoted as mean percentages ± SEM, Values in the same column with different superscripts differ significantly ($p < 0.05$).

keywords: HMC, Fibroblasts, cells and DNMT1

MANAGEMENT OF TEA MOSQUITO BUG, *Helopeltis antonii* Signoret USING CHEMICAL INSECTICIDES AND BOTANICAL IN CASHEW CROP

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Field trail was conducted on farmer's field at two different locations in the Dangs during 2017-18 to evaluate the efficacy of six different treatment comprised of insecticide molecules and azadirachtin 10000 ppm against tea mosquito bug in cashew. The results revealed that, among the different treatment tested significantly highest 62.60 per cent mortality of tea mosquito bug was observed in treatment T6 (buprofezin, azadirachtin, buprofezin). The next effective treatments were T4 (diafenthiuron, azadirachtin, diafenthiuron) and T5 (pymetrozine, azadirachtin, pymetrozine) which remained at par and proved equally effective as they registered 54.24 and 52.69 per cent mortality of TMB. The highest nut yield (1027 kg/ha) and cost benefit ratio (1:7.13) was recorded in treatment T6 (buprofezin, azadirachtin, buprofezin).

Keywords: Cashew, tea mosquito bug, mortality, buprofezin, azadirachtin,

EFFECT OF CHEMICAL TREATMENT ON LIGNIN CONTENT OF *Sesbania aculeata* (DHAINCHA) FIBRES

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The natural fibres have dominated the textile industry for a long time. But due to advent of synthetic fibres, the use of natural fibres decreased to some extent. The environmental problems associated with use of synthetic fibres have encouraged the use of natural resources like bast fibres. The bast fibres obtained from leguminous plant *Sesbania aculeata* of Fabaceae family commonly known as dhaincha was selected for the research study. Dhaincha provides variety of utility purposes like

green manure, fibres, wood, fodder, fish nets, sackcloth and paper. The crop is mainly used as manure plant as it improves nitrogen content of soil. The crop requires low maintenance cost, is fast and annual growing, thus, offers opportunities in conducting scientific researches. The high lignin content present in the crop cause major hinderance to extend the uses of crop in other areas. Hence, the present study was planned to measure the effect of chemical treatment applied for delignification on lignin content of *Dhainchafibres*. The effect of experimental parameters like concentration of chemicals and process time were assessed by response surface methodology using Box-Behnken design. The lignin content of control *Dhainchafibres* was observed to be 21.94%. The *dhainchafibres* treated with acetic acid (2.5%), sodium chlorite (5%) and sodium hydroxide (1.5% with process time-10 minutes) yielded the highest lignin content (18.58%) whereas the minimum lignin content was obtained in fibres treated with acetic acid (17.5%), sodium chlorite (35%) and sodium hydroxide (1.5% with process time-10 minutes). The decrease in lignin content of the *dhainchafibres* indicated that softness of fibres improved considerably after chemical treatment. The experimental results showed that there was a significant effect of acetic acid, sodium chlorite, sodium hydroxide and process time on the lignin content of fibers. The interactive effect of these parameters on lignin content of fibres showed that with increase in the concentration of acetic acid and sodium chlorite the lignin content in fibres decreased which helped to improve properties of *dhainchafibres*. The decrease in lignin content of *Dhainchafibres* would help to soften fibres so that it can be used in varied end uses and expand the areas of use.

Keywords: Bast fibres, delignification, chemical treatment, plant lignin, response surface methodology.

CONSERVATION TILLAGE FOR SUSTAINABLE AGRICULTURE

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The growing concern for food security through improved soil management techniques demands identification of an environmentally friendly and crop yield sustainable system of tillage. Tillage is defined as the mechanical manipulation of the soil for the purpose of crop production affecting significantly the soil characteristics such as soil water conservation, soil temperature, infiltration and evapotranspiration processes. This suggests that tillage exerts an impact on the soil purposely to produce crops and consequently affects the environment. As the world population is increasing so the demand for food is increasing and as such they need to open more lands for crop production arises. The yearning for yield increases to meet growing demand must be done in a way that soil degradation is minimal and the soil is prepared to serve as a sink rather than a source of atmospheric pollutants. Thus, conservation tillage, along with some complementary practices such as soil cover and crop diversity has emerged as a viable option to ensure sustainable food production and maintain environmental integrity. Conservation tillage is any tillage system that leaves at least 30% of the soil surface covered with crop residue after planting to reduce soil erosion by water. The principle of conservation tillage involves maintenance of surface soil cover through the retention of crop residues achievable by practicing zero tillage and minimal mechanical soil disturbance. Retention of crop residue protects the soil from the direct impact of raindrops and sunlight while the minimal soil disturbance enhances soil biological activities as well as soil air and water movement. conservation tillage in its many and varied forms holds promise for the sustainability of agricultural productivity and the environment by reducing production costs, preserving soil quality, reducing herbicide, weeding labor input costs, machinery usage, fuel cost and greenhouse gas emissions.

Keywords: Conservation tillage, crop production, sustainable agriculture and zero tillage

PHYSICAL PROPERTIES OF CHIA (*Salviahispanica* L.) SEEDS

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The important physical properties of white and black coloured Chia seeds relevant to the design of processing equipment were determined as per the standard procedure. The important physical properties viz., size, shape, geometric mean diameter, sphericity, aspect ratio, bulk density, true density, porosity and thousand grain weight were determined at moisture content of 11.12% and 10.30% on wet basis, respectively for white and black coloured chia seeds. The mean value of characteristic dimensions, length, width and thickness were 1.982 ± 0.097 , 1.274 ± 0.037 and 0.802 ± 0.038 mm for white and 1.860 ± 0.102 , 1.220 ± 0.028 and 0.868 ± 0.014 mm for dark seed, respectively. The geometric mean diameter of white seed was 1.264 ± 0.027 mm and 1.253 ± 0.029 mm for black seed. The aspect ratio of white and black coloured seeds was 0.644 ± 0.038 and 0.658 ± 0.043 , respectively. The sphericity values were found to be 0.639 ± 0.029 and 0.674 ± 0.024 , respectively for white and dark chia seeds predicting the shape as ellipsoid. The average values of bulk density, true density and porosity were 0.661 ± 0.038 g/cc, 0.990 ± 0.010 g/cc and 33.23% for white seeds and 0.742 ± 0.008 g/cc, 1.130 ± 0.020 g/cc and 34.34% for dark seeds, respectively. Thousand grains weight was 1.299 ± 0.057 g for white and 1.338 ± 0.024 g for dark seeds.

Key Words: Chia seeds, Physical properties, properties of chia seeds

DIVERSITY OF SPIDER FAUNA IN AGRO ECOSYSTEM OF CHARKHET, NAINITAL DISTRICT, UTTARAKHAND

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Spiders or Araneae are members of the spider family Arachnida. They are the most common group of builders of spiral wheel-shaped webs often found in gardens, fields and forests. Present Investigation was carried out on the spider species composition in the different cropping system Charkhet Nainital districts of Uttarakhand, India. The study was conducted from July 2019 to December 2019. The sample is obtained using hand picking, Ground hand collection, Aerial hand collection and sweep netting method. All diversity indices like Simpson Indices, Shannon-Weiner's diversity and Species Richness of spiders are found. The investigation revealed the presence of 26 spider species belonging to the 11 families. The most dominant species was *Argiopepulchella* comprises highest numbers of individuals (23) and most dominant family was Araneidae. Based on foraging behaviour, the collected spiders were classified into 6 ecological guilds. These were such as majority of collected spiders were belongs to Orb weavers. The study on difference in the distribution and diversity of the spiders was carryout and was found to be influenced by the environmental condition, habitat type and vegetation structure.

Key words: spider, agro ecosystem, tomato, diversity, charkhet.

DIVERSITY AND DISTRIBUTION OF SPIDER FAUNA IN SOME AGRICULTURAL CROPS IN KHURPATAL, NAINITAL DISTRICT, UTTARAKHAND

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Spiders are one of the most numerous groups of terrestrial predators and these are found in diverse environments such as agro ecosystems and nearby areas. The study provides a checklist and the diversity of spiders from three different crops namely Red lentils, black eyed beans and tomato of Khurpatal district Nainital, located in hilly area of Kumaun region of Uttarakhand, India. The sample is obtained using hand picking, Ground hand collection, Aerial hand collection and sweep netting method. All diversity indices like Simpson Indices, Shannon-Weiner's diversity and Species Richness of spiders are found higher in tomato (0.97, 3.47, 6.29) and then black eyed beans (0.97, 3.40, 5.98) and less in red lentils (0.96, 3.25, 5.47) respectively. The investigation revealed the presence of 39 spider species belonging to the 14 families and 30 genera. The most dominant species was *Argiopepulchella* comprises highest numbers of individuals (33) and most dominant family was Araneidae (8species) and Salticidae (8species). The highest number of individuals was observed from tomato crop (259) and than black eyed beans (210) and lowest from red lentils (167). Based on foraging behaviour, the collected spiders were classified into 6 ecological guilds. These were such as majority of collected spiders were belongs to Orb weavers (40.62%). The study on difference in the distribution and diversity of the spiders was carryout and was found to be influenced by the environmental condition, habitat type and vegetation structure.

Key words: spider, Agro ecosystem, Red lentils, Khurpatal, Guild structure

EVALUATION OF EFFECT OF HYDROLYZED MOLASSES TREATED MUSTARD OIL CAKE ON DAILY DRY MATTER INTAKE, BODY WEIGHT AND NUTRIENT DIGESTIBILITY OF SHEEP

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The study was conducted on fifteen nondescript adult male sheep which was randomly divided into three treatment groups namely UT, FT and MT. The groups were subjected to three dietary treatments namely UT (concentrate mix with untreated MOC+ Molasses + *ad lib* wheat straw); FT (concentrate mix with Formaldehyde treated MOC + Molasses + *ad lib* wheat straw) and MT (concentrate mix with hydrolyzed molasses treated MOC+ *ad lib* wheat straw. The observation was recorded for one month. The parameters observed during the study period were daily DMI, body weight changes and nutrient digestibility. The mean intake (g/d) of concentrate mixture was non-significant ($P>0.05$) among the three different dietary groups. The body weight of the sheep did not vary significantly between the periods ($P>0.05$) and between different treated groups during feeding and metabolic trial. The digestibility (%) values of OM, CP, CF, EE, NFE, NDF and ADF were non-significant ($P>0.05$) between the different treated groups.

EVALUATION OF EFFECT OF HYDROLYZED MOLASSES TREATED MUSTARD OIL CAKE ON THE MILK YIELD AND MILK COMPOSITION OF DAIRY CATTLE

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The study was conducted on fifteen dairy cattle which was randomly divided into three treatment groups namely UT, FT and MT. The groups were subjected to three dietary treatments namely UT (concentrate mix with untreated MOC+ Molasses + *ad lib* wheat straw); FT (concentrate mix with Formaldehyde treated MOC + Molasses + *ad lib* wheat straw) and MT (concentrate mix with hydrolyzed molasses treated MOC+ *ad lib* wheat straw. The observation was recorded for two months. The parameters observed during the study period were milk yield, milk composition (fat, total solid, lactose, SNF and protein).The milk yield was significantly ($P<0.05$) higher in FT treated group followed by MT treated as compare to control UT group. There was no significant difference in milk fat among the different treated groups. The other components like Total solid, SNF, Lactose and protein was significantly ($P<0.05$) higher in MT and FT treated groups as compared to control UT group.

SEED GERMINATION AND SEEDLING GROWTH OF WHEAT AND BARLEY UNDER WATER STRESS CONDITIONS

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The study was carried at the department of seed science and technology, Chaurus Campus HNBGU Srinagar uttrakhand in which an adverse effect of water stress induced by PEG on germination and growth of Wheat and Barley were observed during the experiment. Different concentration of PEG 6000 (0.4Mpa, 0.6Mpa, 0.8Mpa, 1.0Mpa) were used to restrict the availability of water for germination and growth of the seedlings. Distilled water were used for the control set of treatment. Both seed germination rate and seedling growth decreased with the increasing water stress.

FORMULATION AND NUTRITIONAL EVALUATION OF MULTI GRAIN PORRIDGE INCORPORATED WITH AMARANTHUS SEEDS

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In college of food science and technology ,Rudrur, Nizamabad, research was conducted to formulate and develop the product instant multigrain porridge by selecting the different grains like sorghum, barley ,finger millet, foxtail millet, barnyard millet, corn , Amaranthus and black gram which are of increasing their demand in recent years due to their ,nutritional content and also these control the lifestyle diseases like diabetes ,reduce the risk of obesity a because the millets have the high fiber content. Amaranthus is used as it is rich in protein, calcium and iron which are required

by human body. Using these grains in different proportions we made treatments like T₁, T₂, T₃ compared with control sample which does not have amaranthus grains and black gram. In this laboratory investigation, amaranth grains and black gram along with other millets and cereals are taken and soaked and then pressure cooked and then dried and milled to a coarse powder. Three different samples are prepared with varying amaranth grain and blackgram percentage i.e., different proportions like 8%, 10%, 14% and 8%, 10%, 20%. These formulations were analyzed to study proximate composition, sensory evaluation, Water absorption capacity, cooking time. From proximate analysis it was concluded that Amaranthus seeds and blackgram incorporated instant multigrain porridge was rich in protein and iron. From sensory analysis it was concluded that instant multigrain porridge prepared with 14% Amaranthus seeds and 20% blackgram was best in terms of taste, flavour and overall acceptability.

Keywords: Nutritional quality, Organoleptic evaluation, Multigrain, Porridge, Amaranth grains, Millets

ASSESSMENT OF NUTRIENT CONTENT AND PHYTOTOXICITY OF CONVENTIONAL AND NON CONVENTIONAL ORGANIC MANURES COMMONLY USED IN AGRICULTURE

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Soil organic matter (SOM) plays a pivotal role in maintaining soil quality and agricultural sustainability. Availability of conventional organic manures like farmyard manure, poultry manure, bone meal, groundnut cake, neem cake etc. are very limited and are comparatively costly. The new thermochemical waste processing method reported by Sudharmaidevi *et al.* (2017), provides a quick and sustainable solution for hygienic waste disposal and the production of organic manure. In the present study organic manures were prepared in four different methods and along with FYM were characterized for nutrient content and phytotoxicity levels. The aerobic compost (AC), microbial compost (MC), vermi compost (VC), and thermo chemical organic fertilizer (TOF) were prepared from identical wastes and TOF-F was prepared by fortifying the TOF. The nonconventional organic manure when fortified (TOF-F) had the highest N content of 3.27% followed by MC (2.89%). The P content was significantly different between the manures. The K content of organic manures varied in the order TOF-F > TOF > VC > MC > AC > FYM. Significant difference was not recorded between manures in the case of Ca content. The manure type MC (0.36%) recorded the highest Mg content and TOF-F registered the highest value of S (42.7 mg kg⁻¹). Significant difference was noticed among the manures in the content of Fe, Zn, Cu, Mn and B. For cucumber the treatment MC (76%) recorded the highest GI followed by TOF-F (73%). The treatment TOF-F (81%) recorded highest GI followed by VC for amaranthus and VC (76%) showed the highest GI for tomato followed by TOF-F (75 %).

Keywords: Organic manures, Nutrient content, Germination index

EFFICACY OF NEWER INSECTICIDES AND MICROBIAL INSECTICIDE AGAINST THE MANAGEMENT OF POD BORER, *Helicoverpa armigera* (Hubner) IN CHICKPEA

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Chickpea, (*Cicer arietinum*), also called Bengal gram of the family Leguminosae, widely grown for its nutritious seeds. Chickpeas are an important food plant in India, Africa, and Central and South America. The seeds are high in fibre and protein and are a good source of iron, phosphorus, and folic acid. The production and quality of chickpea are considerably affected by array of insect pests infesting at different stages of crop growth. Gram pod borer (*Helicoverpa armigera* Hubner and, Cutworm (*Agrotis ypsilon*) attack the chickpea (*Cicer arietinum* L.) crop. Among these insect species, *Helicoverpa armigera* Hubner) is the most serious pest of chickpea and other crop plants all over the world (Patankar et al., 2001). In server cases, it causes about 5-90 % losses in seed yield (Lal, 1996). The investigations were conducted on newer insecticides and microbial insecticides against tomato fruit borer, *H. armigera* at JNKVV, Krishi Vigyan Kendra Chandan Nagar Chhindwara (M.P.) during the Rabi season of 2019-20. Among different treatments, mean larval population with chlorantraniliprole 18.5 SC (0.9) was found most effective against pod borer followed by spinosad 45 SC (1.50), emamectin benzoate 5 SG (1.80) and *Beauveria bassiana* 1.15 WP (2.0) proved least effect. All the insecticides significantly increased the yield of chickpea over control.

Keywords: *Helicoverpa armigera*, *Cicer arietinum*, microbial Insecticide

HYDROGEL APPLICATION IN MODERN AGRICULTURE

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Nowadays water management is considered one of the major challenges for all countries. It is estimated that by 2030, global water demand is probable to be 50% higher than today and this will lead us towards water scarcity, in the same time agricultural sector used over 70 percent of freshwater in most regions of the world. Among 195 countries in the world, India ranks 41 in the moisture stress. Among all the cultivated areas in India 60% lands are under dryland condition and 30% area have less rainfall. So cultivation under shortage of water is a major problem in India. Under such condition, application of hydrogel can be used as an alternative which can reduce the problem of water scarcity. Hydrogels are the network of crosslinked polymer chains which can swell to absorb huge volume of water. . Hydrogels absorb and hold rain and irrigation water hence it helps to reduce deep percolation of water. Hydrogel releases water and nutrient to the plants when soils around root zone of plants starts to dry up. Application of hydrogel polymer used to create a water reservoir near the root zone of plants, improve the capacity of available water to plant, enhances plant growth and increases yield and reduces cost of cultivation. Hence, hydrogel plays an important role in modern agriculture.

Keywords: hydrogel, water scarcity, dry land

EFFECT OF DIFFERENT NITROGEN LEVELS ON GROWTH ATTRIBUTES, YIELD, NUTRIENT UPTAKE AND CONTENT OF DIFFERENT RICE (*Oryza sativa* L.) VARIETIES UNDER TRANSPLANTED CONDITION

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Rice is very responsive to nitrogen fertilizer under transplanted condition but may vary its nitrogen use efficiency and uptake by different varieties. A field study was conducted during rainy season of 2017 to evaluate the four nitrogen levels and three rice varieties under transplanted condition at Agricultural Research Farm, Banaras Hindu University, Varanasi, Uttar Pradesh. The experiment was carried out in a split-plot design with three replication. The total number of treatment is twelve involving three rice varieties (V1- BPT-5204, V2- Rajendra Kasturi and V3- HUBR 2-1) in main plots and four nitrogen levels (N1- 100, N2- 120, N3- 140 and N4- 160 kg ha⁻¹) in sub-plots. Rice variety BPT- 5204 recorded significantly higher growth parameters viz. leaf number hill⁻¹ 37.17, SPAD value (chlorophyll content) 31.83, higher number of day taken to 50 percent flowering (103 day), maturity (130.17 day), grain yield (50.73 q ha⁻¹), biological yield (112.90 q ha⁻¹) and harvest index (0.45) as well as NPK uptakes by grain (60.96, 13.01 & 10.95 kg ha⁻¹) and straw (29.72, 7.15 & 101.55 kg ha⁻¹) as compare to other varieties however, straw yield (62.17 q ha⁻¹) higher HUBR 2-1 as compare to rest of the other varieties. Among the nitrogen levels N4-160 kg N ha⁻¹ was recorded significantly higher same parameter as compared to other nitrogen levels. Hence, application of N @ 160 kg ha⁻¹ along with rice variety BPT- 5204 can be recommended for achieving higher rice yield, nutrient uptake and efficiency.

Keywords: Transplanted rice, nutrient uptake, economics and grain yield.

ORGANIC FARMING - A MAJOR COMPONENT FOR SUSTAINABLE AGRICULTURE

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In ancient time, agriculture was practiced without the use of artificial chemicals. During the 19th century, the firstly use of artificial chemicals such as fertilizers and pesticides occurred. Modern agriculture involving use of fertilizers and pesticides has negatively impacted the environment by soil fertility, development of insect resistance, genetic variation in plants, increase in toxic residue through food chain and animal feed thus increasing health problems and degradation of environment. In the 20th century, organic farming came into existence with rapid change in the farming practices. It made use of environment friendly practices by avoiding or without use of artificial chemicals and making use of organic matter to produce crops. Organic farming is a production management system excluding of all synthetic off-farm inputs but dependent on-farm agronomic, biological and mechanical methods like crop rotations, animal manures, crop residues, off-farm organic waste and biological system of nutrient mobilization and plant protection etc. that promotes and enhances biodiversity and health of the agroecosystem. Organic farming provides nutrients to the plants and improves the soil physical, chemical and biological characteristics of soil. Organic farming through sustainable agriculture not only meets the current generation's food in an environment friendly manner but also meets the needs of future generations and maintains our environment.

Keywords: Organic farming, soil fertility, organic matter, sustainable agriculture.

EFFECT OF CROP RESIDUE MANAGEMENT IN ORGANIC FARMING: A REVIEW

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In the past during post-independence period due to the challenges of food security, synthetic fertilizers were used vigorously to increase the crop production to meet the national food security. But by 20th century the use of excessive chemical fertilizers led to depletion of soil structure and its fertility status, which paved the way for use of organic fertilizers in the country but in recent years due to the rise in scarcity of alternative organic amendments, the retention of crop residue in fields can be considered as key in promoting physical, chemical, and biological attributes to soil health in agricultural systems of our country. It shows numerous positive effects like improvement in carbon storage, soil organic matter, and soil moisture retention, enhanced nutrient cycling, and decreased soil loss, and ultimately improved soil quality. Along with environmental and soil health benefits it also has some limitations like residue retention on crop performance attributed to nitrogen immobilization, water logging and decreased soil temperature have also been reported in some environments, yield reduction has also been noticed in cases of excess residue incorporation, the reasons may be due to production of toxic compounds, development of pathogens and poor nutrient relationship during residue decomposition. However, residue management techniques should be used to increase the positive effects. This can only be achieved with the better understanding of residue, soil, and management factors and their interactions, which affects the decomposition and nutrient release processes. Data on nitrogen benefits and nitrogen recoveries from residues show that a considerable potential exists from residues, and especially from leguminous residues, not only in meeting the N demands of the succeeding crops, but also in increasing the long-term fertility of the soil.

Keywords: Crop Residue management, Carbon storage, Nutrient cycle, Soil health, and Organic farming.

INTEGRATED NUTRIENT MANAGEMENT AN APPROACH TO SUSTAINABILITY

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Chemicals are widely used in agriculture to increase the production maximum use of chemicals can decline the fertility of soil. Sustainable agriculture is the key to overcome the increasing demand for food in a sustainable way. Integrated nutrient management can play an important role in sustainable agriculture. Mismanagement of plant nutrients have made task of sustainable agriculture more difficult. Maximum yield can be attained without compromising the soil fertility with the help of integrated nutrient management. Integrated farming can help to maximize the yield of small holder farmers because with less input we can attain maximum yield with help of INM. Both organic and inorganic fertilizers are used in integrated nutrient management. Sustainable agricultural production incorporates the idea that natural resources should be used to generate

increased output and income. Especially for low income groups without depleting the natural resources. INM maintains soils as storehouses of plant nutrients that are essential for vegetative growth. Main goal of INM is to integrate the use of all natural and manmade sources of plant nutrients, so that crop productivity can enhance in an efficient way without sacrificing the soil productivity.

Keywords: Sustainable agriculture, Integrated nutrient management, Organic fertilizer, Inorganic fertilizer, Yield

THE EFFECT OF TWO DIFFERENT CRYOPROTECTANTS ON SEMINAL ATTRIBUTES OF CRYOPRESERVED SEMEN OF BERARI BUCKS

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The study was conducted to evaluate Tris egg yolk glycerol (TYG) and Tris egg yolk di-methyl sulfoxide (TYD) dilutors on the basis of various macroscopic, microscopic, sperm function tests and enzymes activities at neat semen, post diluted, post equilibrated and post thaw stages in Berari goat semen. A total of 72 ejaculates from 6 mature Berari bucks were collected once a week from the bucks using an artificial vagina and the semen pooled to minimize individual variation. Each pooled ejaculate was split into 2 equal aliquots and diluted with tris base extenders supplemented with two different dilutors having different cryoprotectants i.e glycerol (G) and di-methyl sulfoxide (DMSO). Tris egg yolk glycerol (TYG) had better mass motility, initial motility, total sperm concentration, percentage of live spermatozoa, Hypo-osmotic swelling test (HOST), Acrosome intactness test when compared to Tris egg yolk di-methyl sulfoxide (TYD) groups. On the other hand, TYD showed the more values of abnormal sperm percentage and Enzyme leakage test i.e AST and ALT values. The study indicated that glycerol is still the cryoprotectant of choice for freezing of Berari buck semen.

Keywords: Berari goat, Cryoprotectants, Sperm function test, Enzyme Leakage Test

WOMEN'S SELF-HELP GROUPS COMBAT THE COVID-19 PANDEMIC FOR A SOCIAL CAUSE: DEHRADUN, UTTARAKHAND

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Women at the centre of development has been an important task force in India. During exhausting times, when the whole world is fighting against the pandemic COVID 19, women as a major task force are taking the front role in combating the pandemic in their own ways. Such as meeting shortfalls in masks, sanitizers and protective equipment, and even providing banking and financial solutions to the needy migrants and poor communities. The collective strength of women SHG in rural areas like its urban counterparts are equally proactive in fighting the pandemic with proper planning, flawless execution and backbreaking work. Although they need proper guidance and training. *Krishi Vigyan Kendra (KVK) Dehradun* in Uttarakhand state took an initiative to train the

SHG women during the immense lockdown through Whatsapp on making hygiene mask. Under guidance of KVK Dhakrani, the SHG women in Dehradun prepare and distributed about 10,000 homemade mask to various government and non- government departments and the needy ones. This noble work is not only helping the society in this crucial time when everyone is scared due to the corona virus infection, but also opening a path to the women to earn money for the daily requirements of their family members. The present study aims to highlight the significant contribution of SHG women of Dehradun to curb against the pandemic and suggest the ways to strengthen them economically and socially.

Keywords: Pandemic, SHG women, COVID-19, KVK

COMPARISON OF SINGLE ROW AND PAIRED ROW DRIP IRRIGATION SYSTEMS IN SWEET CORN CULTIVATION

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Land and water are the basic needs for agriculture and economic development of the country. Drip irrigation, one of the micro irrigation methods, in which water is applied frequently at low rates from a low pressure delivery system comprising of small diameter plastic pipes fitted with outlets, called emitters or drippers, directly to the land surface close to the plant where the roots grow. A few low cost automation systems were developed and evaluated their performance based on the parameters like uniformity coefficient, plant height, root depth and cob characteristics like number of kernel rows per cob, cob diameter, length and weight of the cob. In initial stage water was applied in alternative days, from development stage water was applied regularly. With comparison of both irrigation systems, the soil moisture content value of before irrigation and after irrigation is better in single row drip system. Compared to paired row drip method, the height of the plant, number of kernel rows per cob is more in single row drip method.

Key words: Drip irrigation, Automation system, Uniformity coefficient, Paired row drip method, Single row drip method

BREEDING FOR QUALITY PROTEIN TRAIT IN MAIZE

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The chief immediate and long-term objective of plant breeding remains increased productivity/yield to meet the food requirements of day-to-day increasing population. New varieties with improved agronomic traits have been the major factor in increased food production. But an essential component of the economic yield is its quality in order to overcome malnutrition. Breeding the quality traits for crop improvement is achieved by various approaches such as screening of germplasm, mutagenesis, hybridization, interspecific hybridization, somaclonal variation and genetic engineering. For breeding quality traits, the source is taken from a germplasm line, a cultivated variety, a mutant, a somaclonal variant, a wild relative or a transgene. Breeding the

quality traits varies from crop to crop and are generally governed by oligogenes. The main objective for a plant breeder is consumer acceptance and cost effective of the produced qualitative variety. A close interaction between nutritionists and breeders will increase the rate of progress in breeding for nutritional quality. The breeders should concentrate on nutritional (protein) quality rather than nutritional (protein) content. Quality Protein Maize (QPM) is one of the most successful produce achieved by conventional plant breeding (not a genetically modified) and stands as an example for bio- fortification. QPM offers 90% the nutritional value of skim milk, the standard for adequate nutrition value. The future strategies includes identification of diversification and their utilization in the breeding programmes, use of biotechnological tools in the development of plants with novel desirable quality traits.

Keywords: Yield, Quality traits, Oligogenes, Nutrition, QPM

BACILLUS ENDOPHYTES AGAINST *Fusarium* WILT OF TOMATO ALONG WITH ANTIMICROBIAL AND PLANT GROWTH PROMOTION ACTIVITIES

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Bacterial endophytes are considered to have a beneficial effect on host plants by suppressing pathogens and enhancing plant growth by a wide varieties of mechanisms. *Bacillus* are found to colonize plants endophytically and have been identified as plant growth promoting and biocontrol agents against diverse plant pathogens. *Fusarium* wilt of tomato caused by *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.) Synder and Hansen is an important disease that has been known to occur and cause destruction of tomato worldwide. So, in the present study 12 endophytic *Bacillus* spp. isolated from tomato roots collected from different locations of Meghalaya were screened for their ability to suppress tomato *Fusarium* wilt, caused by *Fusarium oxysporum* f. sp. *lycopersici* (FOL) by three methods. Among the 12 *Bacillus* isolates, ERBS51 was found most effective in causing 58.43%, 55.83%, 91.52% inhibition of linear growth of FOL in dual culture, sealed plate method and antagonistic activity in liquid media respectively. All the 12 isolates were identified using 16S rRNA with *Bacillus* specific primers BCF1 and BCR2. The isolates were further screened for hydrolytic enzyme production, antimicrobial and plant growth promotion (PGP) activities viz. Alpha amylase, cellulase, protease, pectinase, lipase, siderophore, HCN and ammonia production, phosphate solubilization, ZnCO₃, ZnO, ZnSO₄, ZnCl and potassium solubilization and found to have varying results. The isolate ERBS51 was found to be positive for majority of the mentioned attributes.

Keywords: Endophyte, *Bacillus*, *Fusarium* wilt, hydrolytic enzyme, antimicrobial, PGP

BATTLE OF HUNGER IN INDIA: STRENGTHS, CHALLENGES AND THE WAY-OUT

ZAHOOR A PAMPORI

India became independent in 1947, when it was still reeling from the impact of the 1943 Bengal famine and world as a whole was experiencing the brunt of world war second, thus India was born hungry in a hungry world. The country leaders were well aware of the challenge that India was expected to face in terms of food security and it was Jawaharlal Nehru who said everything can wait but not agriculture. The first president of India Rajendra Prasad after taking the chair, the first thing he did was to raise the flag at the Indian Council of Agricultural Research, declaring "India's most

pressing task would be to conquer the battle of hunger. The Indian population has increased tremendously from 376 million in 1950 to 1380 million in 2020 and it is agriculture and its allied sectors that sustained such a huge population. India still has a significant proportion of population 14% undernourished, 35% children stunted, 20% children underweight, 52% women of reproductive age anaemic. India could bring out green revolution, white revolution and blue revolution in order to provide food security to its people. India presently is not food deficient; it has attained self sufficiency in food production and stands exports of food. However the irony is that India stands at place 102 in global hunger index with score of 30 that is a matter of concern despite India being self-sufficient in food production. The problem is in making this food available to the people. India needs now nutritional security rather than food security, transformation in agriculture and allied sectors to be free from hunger. The task is tough and precipitated by Covid-19 pandemic, but not impossible. India has much strength but will need research, extension, implementation and policy framing to have sustainable, nutrition sensitive, climate resilient, integrated and smart agriculture to eliminate hunger.

Keywords: Nutrition sensitive agriculture, smart farming, nutritional security, livestock farming.

EFFECT OF CLIMATE CHANGE ON MAJOR TROPICAL AND SUB- TROPICAL FRUIT CROPS

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The climate of earth, although relatively stable for the past 10,000 years or so, has always been changing, mainly due to natural cause such as volcanic activity. But since the 1900s more rapid changes have taken place and these are thought to be mainly man-made. Climate change refers to a change in the state of the climate that can be identified by changes in the mean and variability of its properties and that persist for an extended period, typically decades. Climate change is becoming an observed reality, very likely due to the increase of anthropogenic greenhouse gas concentration. We have to expect rise in average temperatures, atmospheric CO₂ concentration, soil salinity in some areas and receiving erratic rainfall. Warm temperature increased the rate and percentages of anther dehiscence and fertilization in mango compared to cool temperatures. Night temperature more than 17 °C during flower induction period in December showed detrimental effect leading to poor flowering and ultimately affecting the crop yield.

Keywords: Climate change, Temperature, Rainfall and fruits *etc.*

TECHNOLOGY FOR CAMEL MILK CHEESE PRODUCTION BY CASEIN FAT ADJUSTMENT WITH MINIMAL SOLIDS LOSSES IN WHEY

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Camel milk is a new option for production of dairy products and also gaining popularity due to its therapeutic value. Production of camel milk cheese remained as a difficult task as bovine chymosin unable to coagulate camel milk and also higher losses of solids in cheese whey. In the current study effect of casein fat ratio of camel milk on cheese whey losses was studied. Milk was clarified, separated further adjusted to two different C/F ratio 0.6, 0.9 and compared with normal milk (0.76

C/F). After standardization milk was subjected to LTLT pasteurization, cooled to 40°C added with Thermophilic culture@ 2% (NCDC 144) and ripened for 30 min. Rennet was added @2g/100L at 31°C/45min followed by cooking and cutting. Chemical composition, mineral content and colour values were analysed for the whey obtained from three different C/F ratio milks. Total solids losses in whey from three treatments (0.6, 0.76 and 0.9 C/F) were 5.38±0.20, 5.25±0.19 and 4.13±0.56. Actual cheese yield from treatments were 7.78±0.14, 7.42±0.01 and 8.97±0.17. Calcium losses in whey of three treatments compared with milk were 738.89±41.78, 693.90±21.26, 375.10±24.12 and 1258.75±28.1. Sodium losses were 57.53±15.09, 238.08±13.48, 77.11±11.53 and 446.66±15.94. Magnesium losses were 69.93±3.83, 97.61±5.23, 62.51±0.13 and 107.66±12.26. L* values of three treatments compared with milk were 77.25±0.62, 76.92±0.08, 69.93±0.27 and 84.81±1.95. Similarly, a* and b* values were -2.18±0.12, -2.1±0.05, -2.0±0.02, -1.82±0.1 and 4.15±0.15, 3.99±0.03, 1.50±0.08, 5.28±0.04. Among the three treatments milk with 0.9 C/F standardization has shown significantly lower calcium, sodium and magnesium losses, higher recovery of solids in cheese and lower solids losses in whey.

Keywords: Camel milk, Standardization, Cheese, Technological interventions

HEPAPROTECTIVE EFFICACY OF REDUCED GRAPHENE OXIDE-BETA CAROTENE (rGO- βC) NANOCOMPOSITE AGAINST EXPERIMENT HEPATIC FIBROSIS DISEASE MODEL

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Objective: In this study, albino rats were injected with N-nitrosodiethylamine (NDEA) to induce hepatic fibrosis and rGO- βC to observe possible effect.

Hypothesis: Composite of β-carotene with nanomaterials like reduced graphene oxide (rGO) may facilitate effective delivery of this carotenoid in the targeted organ.

Methods: *Abelmoschus esculentus* extract was used for the reduction of graphene oxide as a green reducing agent. The physical and chemical properties of the rGO and its composite with β-carotene were investigated using electron microscopy, EDX and FTIR spectroscopy. This composite was administered intraperitoneally to albino rats belonging to five different groups: Group-1: Control receiving normal saline, Group-2: rGO treated, Group-3: rGO-βC nanocomposite treated, Group-4: NDEA-treated and Group-5: NDEA + rGO-βC nanocomposite treated. Following sacrifice after two weeks, SOD, GST, catalase, liver function test enzymes and lipid peroxides were estimated. Alterations in the liver structure and collagen deposition were monitored by routine H&E, Picrosirius red stainings and electron microscopy (SEM and TEM).

Results: NDEA administration causes decline in antioxidant enzymes and significant elevation in liver function markers and lipid peroxidation. H&E, Picrosirius red and electron microscopy revealed deposition of collagen and alteration in hepatic architecture. However, rGO-β-carotene composite restores the deviated antioxidant status, possesses anti-fibrotic potential as revealed by histopathological and electron microscopic studies.

Implications: These results provide useful insight for facilitating the targeted delivery of β-carotene and its application in pharmaceutical products as an antifibrotic agent.

Key words: Hepatic fibrosis, NDEA, rGO, β-Carotene, Screening of antifungal VOCs-producing strain against

ATTITUDE OF BENEFICIARY FARMERS TOWARDS SOIL HEALTH CARD

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The present study was undertaken in the purposively selected Aurangabad district of Marathwada region with two talukas namely Vaijapur and Aurangabad from each talukas ten villages were selected randomly and five soil health card beneficiaries were selected randomly from each of the village thus a sample size of hundred respondents was selected for the present study. The respondents were interviewed with the help of structured schedule prepared for the survey. The data were analysed with the help of frequency, percentage mean and standard deviation. It is found that the respondents were having middle age with higher secondary education status, medium to high land holding and medium social participation, use of information sources, annual income scientific orientation, innovativeness and cosmopolitanism. Majority of the respondents had medium level of knowledge. 50 per cent of the respondents had favorable to most favorable attitude. Less than thirty 35 per cent of the respondents adopted SHC, more over majority of the constraints faced by the respondents were expressed that difficulty in calculating fertilizer dose based on the soil test results, difficulty in understanding the information on SHC without the assistance of extension officer, delay in distribution of SHC, received soil health card after crop harvest, personal constraints associated with illiteracy/low education and lack of trust in the information given in soil health card. However, suggestions offered by the respondents to overcome the constraints were method of calculating dose on the basis of nutrient status should be given in SHC, soil analysis should be done in different laboratories, extension personnel should guide about recommendation of SHC before sowing and explain the utility of SHC, timely and personally distribution of SHC, soil testing laboratory should be established at Taluka level with highly qualified supporting staff, availability of micronutrient status should be displayed, farmer should be trained to take soil sample of its own field and contact number of the scientist and additional information regarding nutrient management should be given in SHC.

Keywords: Attitude, Beneficiary, Soil Health Card

SUSTAINABLE AGRICULTURE AND RESOURCE MANAGEMENT: PROSPECTS AND CHALLENGES

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Farming is a profession of hope and reflects the doubt of uncertainties in agriculture. In India, Agriculture employs about 50 percent of nation work force and provide livelihood for majority of population. India is caught between national demand of food at an affordable price and generating necessary income to provide basic amenities for majority of its population. Keeping this in view, sustainability in agriculture through resource conservation technology is the most pertinent solution to subdue this stint. Globally, the emerging challenges in agriculture are also due to excessive exploitation of fresh water in agriculture as irrigation, impoverished soil, reduction in land holdings, climate etc. Spearheading for smart farming through water management, integrated farming system (IFS), farm mechanization, integrated nutrient management (INM), climate smart cropping is the immediate need of the hour. Besides, the disposal of paddy residue is the major challenge among

agrarians. Hence, paddy residue management is of another utmost importance as it contains nutrients and improves soil-plant-atmospheric continuum. The agricultural waste opens vivid options for its versatile usage and is possible if residue is collected and managed properly. Integrated farming system should be followed and conservation agriculture needs to be practiced, as through zero tillage, stubble management, which will increase the yield with sustainability. Farmers have to adopt climate smart cropping. Youth as pivot, entice sustainability vis-à-vis food security. The level of sustainability thus can be enhanced with inclusive efforts.

Keywords: Sustainability, resource management, climate smart cropping, youth

**ASSESSMENT OF INTER-POPULATION PHENOTYPIC VARIABILITY IN *Vitex negundo* L., A MEDICINALLY VALUABLE SHRUB, RITIKA JAMWAL AND GEETA SHARMA
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V. negundo L. (Lamiaceae), is a medicinally important species containing anti-inflammatory, anti-cancer and hepato-protective. While its leaf extracts are used to cure cough, cold and snake bite, wood provides valuable timber. In view of its importance, analysis of phenotypic variability prevailing in its populations becomes important to isolate elite lines. For this purpose, nine nirgundi populations from Govindsar, PalliMorh, KharrootMorh, Billawar, Rajouri, Kolka, Botanical garden, Sagoon and Domana have been studied for phenotypic aspects. These correspond in qualitative traits except for an offtype growing in Domana, which is different from the rest in being tallest, early blooming, predominantly bearing trifoliolate leaves and flowers with varying number of stamens. Analysis of these for vegetative (tree height, number of leaves per branch length, percentage of different leaflets and leaf size) and reproductive (inflorescences length, number of flowers per inflorescence and length of different floral organs) quantitative traits revealed that, plants of Domana are tallest and those of Billawar bear maximum and largest leaves. In light of these features, they seem to have more agro-economic value. Contrary to these, plants of Sagoon are smallest and bear smaller leaves. Statistical analysis of different populations using quantitative traits results in isolation of an offtype and plants of Sagoon from the remaining populations.

VERTICAL FARMING: A SMART OPTION TO SUSTAIN URBAN FOOD PRODUCTION

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Some of the emerging global problems are exponential growth in human population, long-term decreasing per capita stock of agricultural land, rapid rate of urbanization and decreasing availability of water use for increased food production. A smart integration of technology is needed to create a sustainable urban food production system for the expanding urban population. Vertical farming is such an innovation. It is a system of commercial farming whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fibre or other products or services by artificially stacking them vertically above each other. There are different types of vertical farms which include simple designs where a plastic container is used for growing the plants and they are hanged like containers, trellies, PVC pipes can be used. There are building based vertical farms either in abandoned buildings or new multistory buildings. Recycled shipping containers are also used for housing vertical farming systems and these shipping containers serve as standardized modular chambers for growing plants, often equipped with LED lighting, vertically stacked hydroponics and

smart climate controls systems. There are deep farms where vertical farm is built from refurbished underground tunnels or abandoned mine shafts. Temperature and humidity are generally maintained low and constant in deep farms. Based on growing media used in the vertical farms the different vertical farms include hydroponics system (Hydroponics is a technology for growing plants in nutrient solution with or without the use of an artificial medium), aquaponics system (Fishes are grown in indoor ponds, producing nutrient rich waste that is used as a feed source for the plants in the vertical farm) and aeroponics system (neither use any liquid or solid medium to grow plants, instead, a liquid solution with nutrients is misted in air chambers where the plants are suspended).

Keywords: Aeroponics, Aquaponics, Hydroponics, Vertical farming

PROS AND CONS OF KRISHI VIGYAN KENDRA

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Krishi Vigyan Kendra is a Government of India funded Indian Council Agricultural Research Project implemented at district level for enhancing the productivity and livelihood through scientific extension works. Realizing the importance of technology dissemination in the changing scenario of food and nutritional security, ICAR intervened in a big way. All the first line extension projects were merged and brought under single umbrella of KVK. The major emphasis was to enhance the production and productivity as well as to generate household income and employment of farming community. It was also envisaged that these extension works will be act as model for extension agencies and also catalyzed to improve the existing systems for better delivery mechanism. Krishi Vigyan Kendras have effective institutional link between agricultural research system and extension education network in the country. KVKs have grown into a large network in the country and working under the administrative control of various organizations. KVK conducts on-farm testing to identify the location specificity of agricultural technologies under various farming systems and frontline demonstrations to establish its production potentials on the farmers' fields. It trains the farmers to update their knowledge and skills in modern agricultural technologies and trains extension personnel to orient them in the frontier areas of technology development.

MULTI-LOCATION EVALUATION OF BARLEY (*Hordeum vulgare* L.) GENOTYPES BY THE ANALYSIS OF AMMI MODELS

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Barley is one of the ancient crops in the world with higher adaptive capacity. A genotype is considered to have wide adaptation if its yield performance is better and stable against environmental changes. The interaction and magnitude of genotype adaptation by environment factors varied either. The objective of the current study is to assess the adaptation of different genotypes of barley interacting with different environmental conditions in Bangladesh context. This experiment included eleven barley genotypes against checks (BARI Barley-7) at Bangladesh

Agricultural Research Institute in 2019-2020. Analysis of variance (ANOVA) detected significant differences among genotypes for most observed traits both separated and combined analysis. Observations attained significant differences over locations for almost all traits. The combined ANOVA and the AMMI analysis for grain yield across environmental gradients revealed significant results that hold 60.08% of the total variation. Considering the mean, bi and S^2_{di} for grain yield, it was evident that all the genotypes showed differential responses in terms of adaptability under different environmental conditions. The genotype INBYT E9/18 (3.32 ton/ha) and BHL-32 (3.01 ton/ha) were with higher yield and more stable to environmental changes. On the other hand, INBYT E4/18 (3.14 ton/ha), INBYT E5/18 (3.13 ton/ha) and BHL-33 (2.62 ton/ha) exhibited stable over all environments.

Keywords: AMMI analysis, Genotype, Environment, Interaction

TOOLS OF INFORMATION COMMUNICATION TECHNOLOGIES (ICTS) IN NEIGHBORING NATION BANGLADESH: REVIEW AND A VIEW

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Information and communication technology is an integration of collective form to combine field of computers and various information systems to find out the desired solutions to the users. It has affected every walk of the human life at local, national and global level. *ICTs have got mainstreamed as a tool to achieve development goals, in the sustainable mode. It has been used in the development sector for a substantial amount of time. In present era newly emerge developing nation* Bangladesh explored various tools and dimensions of ICT. Informational videos can be made on the various aspects that a farmer needs information on. Information on pre-harvest, harvest and post-harvest agriculture best practices, marketing, business management, financial management and so on is crucial on present era. One of the first uses of community video in Bangladesh was by Poverty Elimination through Rice Research Assistance (PETTRA) project in 2003, and has since been used by organizations such as Access Agriculture and digital green. Community radio typically serves a very local community, where the content is driven by the needs of that community and often produced by the community members themselves. Some of the ICT tools are IVR (Interactive voice response), Community Video, SMS, USSD is short for Unstructured Supplementary Service Data, Web-based platforms, Social Networking, Inclusive Digital Finance, Mobile App-based agro-advisory services, Mobile app-based market services, Satellite-based GIS.

EARLY DETECTION OF *SCLEROTINIA SCLEROTIORUM* THROUGH LOOP MEDIATED ISOTHERMAL AMPLIFICATION AND ITS QUANTIFICATION BY RT-PCR ASSAY

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The Ascomycete *Sclerotinia sclerotiorum* is a destructive plant pathogen with a very extensive host range. This fungus causes white mold disease in Indian mustard (*Brassica juncea*) that leads to upto 40-80% yield loss at some locations in Rajasthan, Punjab and Haryana. Loop-mediated isothermal amplification (LAMP) PCR technique was used which not only detected ten different isolates of *S. sclerotiorum* collected from different regions of north India but also were also differentiated these fungal isolates from *Puccinia striiformis* sp. *tritici*. and *Fusarium oxysporum* sp. *ciceri*. 3 sets of LAMP primers were designed using Primerexplorer V4 software. LAMP reaction was set using Warm colorimetric LAMP 2X master mix (Biolabs) at 63°C for 60 min in water bath. The tubes were visually assessed for colour change, yellow for positive and pink for control and negative samples. The samples were then subjected to agarose gel electrophoresis to check specified product. Primer pair F2-B2 from LAMP primer set I with an amplified product size of 203bp was used to make standard curve of the isolate BIK2. Further, qRT (quantitative real-time) PCR conferred that by comparing CT value of samples with Standard curve, approximately 2550 genome copies of *Sclerotinia sclerotiorum* can be detected by the LAMP primer. Thus, it was concluded that LAMP and qRT-PCR are highly sensitive, less time-consuming for early detection of prevalent pathogen.

Keywords: colorimetric, Real-Time PCR, standard curve.

ENHANCING ABIOTIC STRESS TOLERANCE IN VEGETABLE CROPS: ROLE OF CONVENTIONAL AND MOLECULAR BREEDING APPROACHES

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For many years, plant breeders focused on breeding for biotic stresses but climate change and consequently appearance of abiotic stresses has shifted the plant breeders' priority towards breeding for abiotic stresses recently. Vegetables are important sources of many nutrients, including potassium, dietary fiber, folate, vitamin A, and vitamin C, therefore, vegetables are of great importance since they contribute as a crucial source of nutraceuticals in daily human diet (Ramya and Patel 2019). The vegetable crops are short duration and has a very specific edaphic and climatic requirement. Thus, the effects of abiotic stresses are more pronounced in vegetables. Globally, vegetables crops yield is reduced more than 50% due to abiotic stresses (Bray *et al.*, 2000). Drought and salinity are becoming particularly widespread in many regions and may cause serious salinization of more than 50% of all arable lands by the year 2050 (Machado and Serralheiro, 2017). Abiotic stresses such as drought (water stress), excessive watering (water logging), extreme temperatures (cold, frost and heat), salinity and mineral toxicity negatively impact growth, development, yield and seed quality of crops (Gull *et al.*, 2019). Different conventional methods as introduction, selection, hybridization, pedigree method mutation breeding etc. are used for improving abiotic stress tolerance in vegetable crops. But conventional breeding methods alone are not sufficient in development of stress tolerant varieties, modern molecular breeding methods like genetic engineering, somaclonal variation and marker assisted breeding have great potential to be used in future for breeding crops against abiotic stresses (Varshney *et al.*, 2011). Grafting is another approach for development of vegetable varieties tolerant to abiotic stresses. Therefore, to meet the nutritional needs of ever-increasing population and to mitigate the challenging environmental conditions, different breeding strategies can be utilised to enhance abiotic stress tolerance in vegetable crops.

Keywords: drought, salinity, abiotic stresses

DEARTH PERIOD AVAILABILITY OF NECTARIFEROUS AND POLLENIFEROUS BEEFLORAL DIVERSITY FOR *Tetragonula* spp.

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Stingless bee, a very important pollinator acts as an indicator of ecosystem health. It forages and pollinate number of flowering plants which ultimately ameliorate the productivity of plants and simultaneously gaining rewards of nectar and/or pollen from the plants. The present investigation was conducted with the objective to find out the nectariferous and polleniferous beefloral plants visited by of *Tetragonula* spp. for the purpose of nectar (N) and/or pollen (P) collection during dearth period at Navsari Agricultural University campus in the South Gujarat condition. The significance of *Tetragonula* spp. as a good pollinator was established by its foraging activity for collection of nectar/ or pollen during dearth period from July to September months of 2018-19. During July month, 13 number of beefloral plants comprising 4 tree, 5 shrub, 3 herb and 1 climber species. During this month of dearth period, total of 5 Pollen rewarding plants (P) and 8 Nectar rewarding plants (N) were visited by *Tetragonula* spp. In out of total 17 plant species in August month, 5 tree, 7 shrub, 3 herb and 2 climber species having 6 NP, 6 P and 5 N. Further in September month 27 beeflora comprising 8 tree, 4 shrub, 10 herb and 5 climber having 8 NP, 18 P and 2 N were visited by *Tetragonula* spp. Overall total 48 number of beeflora consisting of 12 tree species, 13 shrub species, 16 herb species and 7 climber species were visited by the *Tetragonula* spp. Again, out of 48 bee floral species, 15, 21 and 12 number of plants were rewarded with both nectar and pollen (NP), pollen (P) and nectar (N) respectively foraged by the *Tetragonula* spp. Therefore, these beeflora can be propagated and managed in the South Gujarat condition during dearth period for success of meliponiculture.

Keywords: Stingless bee foraging, Dearth period, Nectar, Pollen, *Tetragonula* spp.

ROLE OF CROP MODELS IN DEVELOPMENT OF AGRICULTURE

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Crop models are mathematical equations that represents a real world system, reactions that occur within the plant and interactions between the plant and its environment. Unlike in the fields of physics and engineering, universal models do not exist within the agricultural sector. Models are built for specific purposes and the level of complexity is accordingly adopted. There are various models used in agriculture like DSSAT, CropSyst, EPIC, AQUACROP and APEX etc. There are structured for varying subsystems and these models can be built to simulate a specific crop or a specific aspect of the crop production system. These models are based on comprehensive climatic, soil and physiological data which makes them capable being adopted universally as they support extrapolation to alternative cropping cycles, crop and locations etc. Also capable of quantifying

temporal and spatial variability. They give acceptable results in relatively short time span and at comparatively low costs enabling the researchers to investigate effect of a large number of management strategies which would be very cumbersome and costly by using traditional methodologies. Owing to the complexity of the system and lack of availability of proper datasets, it becomes hard to model the agricultural systems. Regardless of its limitations, crop modelling approach remains a promising means of assessing different crop and field managements strategies, yield estimation, crop plaining, access the impact climate change, environmental impact assessment and formulation of policies etc.

Keywords: Crop modelling, Crop model, DSSAT, CROPWAT and Sustainable Agriculture.

VALUE ADDITION TRAINING – A CASE STUDY ANALYSIS AMONG SELF HELP GROUP

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In Cuddalore District there is vast scope for value addition in cashew apple, jack, guava and vegetables. The population of the district is 21.51 lakhs and 80 per cent of the people are engaged in agricultural activities. The income level of farm women is low. The rural youth are also underemployed. With the aim to provide additional off farm employment to farm women and employment opportunities to rural youth a vocational training in value addition of agricultural and horticultural crops produce has been conducted in Krishi Vigyan Kendra with duration of 15- 30 days for 175 beneficiaries comprising 16 Self help groups. After the training the advisory services were rendered to needed trainees. During the year 2007-2008 survey and case study was conducted to assess the impact of training. Out of 16 self help groups 3 SHGs were engaged in value addition and most of them selling their products to nearby families. Jack ready to serve beverage: Kalaimathi Self help group, Keelkumaramangalam village fascinated towards preparing jack RTS beverage on small-scale level. They are selling all the products in the shop specially for marketing the products prepared by the self help group members. Every day preparing 100 bottles of RTS beverage from 3000 ml of fruit juice, 4,750 kg of sugar and 65 gm of citric acid. After paying raw ingredients cost, fuel and labour charges, their monthly income is around Rs.2, 500/-. Vegetable Pickle Production: Jothi Self help group, Manavalanallur village, Vriddhachalam and preparing bitter gourd pickle and mixed vegetable pickle after the training. Later on, they got loan from Indian Overseas Bank. Now selling the products in DRPA shops, Vriddhachalam and also supplying pickles for hotels. At present they are able to sell the pickles of 24 kg/ month of about @ Rs. 100/ kg (including fuel, labour, package and miscellaneous cost). Hence, the net income is about Rs.2000/ month. Weaning foods: Rani SHGS, Ariyanachi Village, Veppur engaged in Varagu and greengram based weaning food preparation for infant & preschool children. The family members of SHG involved in preparing 100 packs of weaning foods of 500 g per pack @ Rs 80/ kg. After paying the raw ingredient cost, fuel and labour charges, the monthly income is around Rs.3000/-. The entrepreneurs have planned to increase their capacity and also new value added produce.

FORMULATION AND NUTRITIONAL EVALUATION OF MULTI GRAIN PORRIDGE INCORPORATED WITH AMARANTHUS SEEDS

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In college of food science and technology, Rudrur, Nizamabad, research was conducted to formulate and develop the product instant multigrain porridge by selecting the different grains like sorghum, barley, finger millet, foxtail millet, barnyard millet, corn, Amaranthus and black gram which are of increasing their demand in recent years due to their nutritional content and also these control the lifestyle diseases like diabetes, reduce the risk of obesity because the millets have the high fiber content. Amaranthus is used as it is rich in protein, calcium and iron which are required by human body. Using these grains in different proportions we made treatments like T₁, T₂, T₃ compared with control sample which does not have amaranthus grains and black gram. In this laboratory investigation, amaranth grains and black gram along with other millets and cereals are taken and soaked and then pressure cooked and then dried and milled to a coarse powder. Three different samples are prepared with varying amaranth grain and blackgram percentage i.e., different proportions like 8%, 10%, 14% and 8%, 10%, 20%. These formulations were analyzed to study proximate composition, sensory evaluation, Water absorption capacity, cooking time.

From proximate analysis it was concluded that Amaranthus seeds and blackgram incorporated instant multigrain porridge was rich in protein and iron. From sensory analysis it was concluded that instant multigrain porridge prepared with 14% Amaranthus seeds and 20% blackgram was best in terms of taste, flavour and overall acceptability.

Keywords: Nutritional quality, Organoleptic evaluation, Multigrain, Porridge, Amaranth grains, Millets

IN SITU IMPLICATIONS OF MICROBIAL CONSORTIA FOR E-WASTE BIOREMEDIATION: A REVIEW

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Electronics industry is one of the fastest growing manufacturing industry in India. But the increase in sales of electronic goods and their rapid obsolescence has resulted in generation of electronic waste (e-waste). Lead, mercury, arsenic, cadmium, selenium, plastic and hexavalent chromium and flame retardants present beyond threshold quantities causes adverse effect on the living organisms and environment. The management of e-waste becomes a global issue in this digital era. Existing conventional practices such as land filling and incineration of these wastes considered inadequate for dealing with the e-waste and may cause detrimental consequences, therefore, indigenous soil bacteria were explored for e-waste treatment through enrichment culture approach followed by screening, identification and their bioformulation used for in situ investigation. Microbes like *Chromobacterium violaceum*, *Pseudomonas fluorescence* and *Bacillus megaterium*; *Burkholderia sp.*; and *Thiobacillus ferrooxidans* and *Lactobacillus ferrooxidans* are found to be capable of

solubilizing copper & nickel, lead & cadmium and ferrous iron, respectively. Soil bacteria were enriched in the presence of e-waste after 30 days of incubation under standard laboratory conditions. Furthermore, bacterial community analysis confirmed that the used strains were persisting and biodegrading in the experimental pits. The biodegradation of e-waste by the selected strains during enrichment and in situ experiment was confirmed by FTIR, TG-DTG-DTA and SEM analysis. The soil enrichment culture technique is the current direct and gold standard technique which suggests that the soil promisingly has the rich habitat for well adapted and potential e-waste degrading microbial communities.

Keywords: E-waste, Bioremediation, Soil enrichment culture, FTIR, SEM.

EFFECT OF INTEGRATION OF ORGANIC AND INORGANIC SOURCES OF NITROGEN ON RICE YIELD

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A field investigation was carried out during Kharif-2017 at the instructional farm of ICAR-Krishi Vigyan Kendra (KVK), Mangaluru, Karnataka state, to study the effect of integration of organic and inorganic source of nitrogen on yield of rice crop grown under submerged condition. The soil of the experimental field was lateritic with acidic pH, medium in available nitrogen, high in phosphorus and low in potassium content. The experimental design was randomized block design (RBD) with three replications. There were with eleven treatments comprising of vermicompost (VC), Poultry manure (PM) and Fish manure (FM) as nitrogen source of organic manure integrated with mineral fertilizer of nitrogen source namely urea in combinations of 25 percent and 50 percent. along with control and treatment comprising application of recommended package of practices. The results indicated that plant height, productive tillers hill⁻¹, panicle length, grain yield and straw yield was significantly influenced by integration of organic and inorganic sources of nitrogen with mineral fertilizer urea. The treatment of receiving 50 per cent VC integrated with 50 percent recommended dose of nitrogen (RDN) recorded significantly higher plant height (92.27 cm), higher number of productive tillers hill⁻¹(16.85), longer panicle length (17.04 cm), high grain yield (5434 kg ha⁻¹) and high straw yield (6817 kg ha⁻¹) compared to control which recorded plant height (72.15), low productive tillers hill⁻¹(9.23), shorter panicle length (11.09 cm), low grain yield (3541 kg ha⁻¹) and low straw yield (4426 kg ha⁻¹). The remaining treatments comprising of various combinations of PM and FM integrated in proportions of 25 and 50 percent also has beneficial effect on yield and yield parameters of rice compared to control.

Keywords: Rice, Nitrogen, vermicompost, poultry manure, fish manure

CONNECTION BETWEEN CAREGIVER STRESS AND QUALITY OF LIFE OF PRIMARY CAREGIVERS OF DEPENDENT ELDERLY

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Caregiving of a dependent elderly is one of the gruelling tasks that develops burden of stress among caregivers. The caregiver stress is an important and negative parameter which is harmful for the primary caregivers. In fact, the burden upon the primary caregivers ultimately changes the perception of quality of life. The overburdening of the tasks viz. household as well as caregiving and that is also without required amount of help leads to poor quality of life of the primary caregivers. The present study was conducted on a sample of 60 primary caregivers from middle

socio-economic status families situated in the district of Ludhiana city of Punjab. Zarit Burden Interview developed by Zarit (1980) was used to assess the caregiver stress of the primary caregivers. The quality of life of the respondents was assessed by the World Health Organization Quality of Life-Bref questionnaire which was developed by World Health Organization (1997). The results revealed significant association between the caregiver stress and the quality of life of the primary caregivers.

Keywords: Primary Caregiver, Caregiver Stress, Quality of Life

INNOVATIVE SOLUTION FOR PLANT NUTRIENT MANAGEMENT USING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

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The world food production has doubled in the past 40 years. This is due to greater application of fertilizers, water, pesticides and crop strains. By 2050, world population is to be 1.5 times the current population and food requirement is projected to be double. The challenge for agriculture over the coming decades will be to meet the world's increasing demand for food in a sustainable way. Soil fertility is the major factor to be looked for getting better yield. Decreasing soil fertility has raised concerns about the sustainability of agricultural production at current levels. Future strategies for increasing agricultural productivity will have to focus on using available nutrient resources more efficiently, effectively, and sustainably than in the past. Integrated management of the nutrients needed for proper plant growth, together with effective crop, water, soil, and land management, will be critical for sustaining agriculture over the long term. Major constraint in promoting balanced use of fertilizers includes inadequate soil testing facilities, wide gap in dissemination of knowledge, lack of awareness among farmers about benefits of balanced fertilization. The timely availability of right information and its proper utilization is as critical as the availability of major inputs required for farming until the produce reaches the consumer. The application of Information and Communication Technology (ICT) can play a significant role in efficient dissemination of information. ICT (Information and Communication Technology) is an umbrella term that includes computer hardware and software, digital broadcast and telecommunications technologies as well as digital information repositories online or offline. The efforts of the Government in the area of ICT have escalated the living standard of Indian farmers and made them ICT-friendly, which has resulted in increased penetration of useful information about crops, soils, climate and cultivation processes. Several measures have been taken for encouraging Indian farmers to be more ICT – friendly. Technologies like Multi-model decision support system, GPS (Global Positioning System), GIS (Geographic Information System) Cloud, web portals, remote sensing, mobile Apps, community radio, video, digital photography, e-mail, audio and video conferencing and even social media platforms like facebook and whatsapp, are intended to fulfil information processing and communications functions for fertilizer recommendations and primarily aiming at the soil health in Indian agriculture. In the recent past Mobile Technology has emerged as a best telecommunication technology resulting in the overwhelming increase in the number of mobile user day by day. With the advent of android phone/smart phone and its compatibility with different mobile apps has created opportunity for vibrant application of ICT in agriculture. Soil Health Card App, IFFCO Kisan Sanchar Ltd., Nutrient manager, Plantix, Kisan Suvidha App, Crop Manager app etc are some of the cutting edge apps for farmers for getting customized agricultural information precise usage of fertilizers.

BIOAGENT AND BOTANICAL MEDIATED PLANT DEFENSE RESPONSE AND MANAGEMENT OF GREY BLIGHT DISEASE IN TEA (*Camellia sinensis*)

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Microbial bioagents are well known in triggering host defense response besides their antagonism against many phytopathogens. Botanicals, known as green pesticides are also reported to enhance plant defense, however, the studies on these lines are limited. An experiment was conducted using some microbial bioformulations and botanicals for their efficacy against grey blight disease and to study host response in triggering plant defense. We evaluated two talc-based bioformulations viz., Biogreen at 2% (composition: *T. viride*, *Pseudomonas fluorescens*, *M. anisopliae*, *Beuvariabassiana* and *B. thuringiensis*); Biometa 2% (*Metarhiziumanisopleae*); Biogreen plus Biometa at 2% each; two botanicals viz., *Pongamia pinnata* at 10%; *Xanthium strumarium* at 10% and their combination (*Pongamia pinnata* plus *Xanthium strumarium* at 5% each) through foliar sprays at 10-days interval during May-September (2018-20) with a total seven treatments and four replications in a randomized block design against naturally infected grey blight susceptible clone TV-23 incited by *Pestalotiopsis theae* in an organic tea (12-year old bushes) production system. The PDI was significantly reduced with treatments involving bioformulations (33.56 to 12.16) than treatments involving botanicals (30.25 to 23.14), displaying the superiority of bioformulations over botanicals at 150 days after spray (DAS). The combination of either botanicals (23.62 PDI) or bioformulations (12.16 PDI) proved significantly better over their individual response of botanicals (30.25-27.14 PDI). PDI reduced gradually in all the treatments except control where PDI increased to 87.28%. All the botanicals and bioformulations not only controlled grey blight incidence through direct action, but also induced defense related enzymes viz., Phenyl alanine ammonia lyase (PAL), Polyphenol oxidase (PPO), peroxidase (PO) and Beta 1,3 glucanase. However, activity of all the enzymes were observed highest in case of combination application of Biogreen + Biometa followed by Biogreen alone and combined application of *P. pinnata* + *X. strumarium*. Our study hence, shows that botanicals and bioagents trigger same defense response in tea, although with varied magnitude and thereby establish role of botanicals and bioagent for organic tea production.

Keywords : Bioagent, botanicals, Grey blight, organic tea, PAL, PPO, PO

AN INSIGHT INTO SCIENCE OF INSECT NEUROPEPTIDE AND ITS ROLE IN INSECT PEST MANAGEMENT: A REVIEW

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Neuropeptides are the neurohormones which are synthesised in the neurons or neuro endocrine cells and are released in the haemolymph. They coordinate physiological functions like mating, oviposition, moulting, water balance, fat mobilization and also act as neuromodulators in circuits of the central nervous system (Yeoh *et al.*, 2017). Neuropeptides are different from neurotransmitters because, former releases in the haemolymph and the later in the neuro-neuro junction or in the

neuro-muscular junction. Most of the neuropeptide receptors belong to the G-protein coupled receptors (GPCRs). However, there are some exceptions like the prothoracicotropic hormone (PTTH) which acts through the activation of receptor tyrosine kinase (RTK). The first neuropeptide isolated was proctolin from cockroach *Periplaneta americana* L. which was found to have myostimulatory activity i.e. muscle contractions in hindgut, reproductive, skeletal and heart muscle (Starratt and Brown, 1975). There are 4782 insect neuropeptides grouped roughly in 54 insect neuropeptide families, covering 23 insect orders (Elakkiyaet *al.*, 2019). Among them greater emphasis is given to four neuropeptides (proctolin, kinin, pheromone biosynthesis activating neuropeptide-PBAN and allatostatin). According to Alford *et al.* (2019) treatment of *Myzus persicae* Sulzer and *Macrosiphum rosae* L. with CAP2b and kinin peptide analogue, hampered the survival of these insects. RNAi induced gene silencing technique is used to induce degradation and down regulation of synthesis and receptor functioning of neuropeptides. Effects of PBAN RNAi induced gene silencing on *Helicoverpa zea* Boddie and *Heliothis virescens* F. larvae showed increased mortality in both the insects (Choi and Meer, 2019). Since neuropeptides are highly effective and specific against insect pests and also environmentally safe. Therefore, it has a great potential for the management of insect pest in an eco-friendly manner.

Keywords: neuropeptides, PBAN, proctolin, kinin, allatostatin.

INFLUENCE OF AGE ON THE HEMATOLOGICAL PROFILE OF *Schizothorax richardsonii* (SNOW TROUT) IN WILD AND FARM CONDITION

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An attempt has been made to assess the hematological profile of snow trout *Schizothorax richardsonii* cyprinid fish of the different age groups. For this purpose specimen from the wild as well as farm-raised has been used. Hematological parameters are in increasing trends with age. All the parameters Hb, Hct, MCV, MCH, and MCHC at the age of 1 year has no significant difference ($p < 0.05$) but the RBC and WBC showed a significant difference in the wild stock compared to farmed raised stock. Hemoglobin showed significant difference ($p < 0.05$) in both the sexes in the wild conditions in comparison to the farmed raised stock of 2 years of age. In general, at the advanced age of 3 years, the fish did not show any significant difference in most of the parameters. MCH showed a significant difference ($p < 0.05$) in the wild stock of 3 years age, and was on the higher side in farmed raised stock with no significant difference. MCHC showed significant difference ($p < 0.05$) in males and females of farmed raised stock as compared with the wild stock. As there are certain natural changes in the blood parameters of fish after maturity is acquired, so it is very important to understand the basic hematological profile of fish. Age-related analysis of hematological parameters is an important tool to set the baseline data regarding the health status of fish at different ages and can be used as on-ground data to assess any impact of stress on fish by comparing the hematological parameters in both farmed and wild fish. Results revealed a similar pattern of hematological parameters in farmed raised stock and wild stock.

Keywords: Snow trout, Blood parameters, Hemoglobin, Farmed raised, Wild stock.

COVID 19: MEDICINAL HERBS CAN STRENGTHEN OUR IMMUNE SYSTEM

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Medicinal herbs can help the people to boost their immunity system during this outbreak of Covid 19. Plants are rich in alkaloid, flavonoids, terpenoids, glycosides, lactones, vitamin C, or the carotenoids hence can increase immune function. According to the Unani and Ayurvedic systems as practised in India, medicinal herbs extract has antimicrobial activity against many genera of bacteria, fungi and viruses and also helps to boost immune system. Therefore, this paper is reviewed to inspire the researchers about the medicinal values of some herbs that fight against viral infection and helps to increase immune power. Medicinal herbs may be helpful for boosting the immune system and preventing colds and the flu. The immune system maintains homeostasis by defending against viruses and bacteria which can cause inflammation in the body, illness and disease. For nutritional deficiencies can impair immune function, increases both the risk and severity of the infection. So it is needless to say that there is a correlation between medicinal plants, immune system, antiviral properties and Covid19. Effort has been made to shortlist the medicinal herbs which is found in West Bengal possess antiviral properties and boost immunity system due to presence of alkaloids, glycosides, terpenes, steroids, flavonoids, tannins, saponins, vitamin C.

Keywords: Medicinal Herbs, Immune System, Traditional Uses, Vitamin C

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umbrella term that includes computer hardware and software, digital broadcast and telecommunications technologies as well as digital information repositories online or offline. The efforts of the Government in the area of ICT have escalated the living standard of Indian farmers and made them ICT-friendly, which has resulted in increased penetration of useful information about crops, soils, climate and cultivation processes. Several measures have been taken for encouraging Indian farmers to be more ICT – friendly. Technologies like Multi-model decision support system, GPS (Global Positioning System), GIS (Geographic Information System) Cloud, web portals, remote sensing, mobile Apps, community radio, video, digital photography, e-mail, audio and video conferencing and even social media platforms like facebook and whatsapp, are intended to fulfil information processing and communications functions for fertilizer recommendations and primarily aiming at the soil health in Indian agriculture. In the recent past Mobile Technology has emerged as a best telecommunication technology resulting in the overwhelming increase in the number of mobile user day by day. With the advent of android phone/smart phone and its compatibility with different mobile apps has created opportunity for vibrant application of ICT in agriculture. Soil Health Card App, IFFCO Kisan Sanchar Ltd., Nutrient manager, Plantix, Kisan Suvidha App, Crop Manager app etc are some of the cutting edge apps for farmers for getting customized agricultural information precise usage of fertilizers.

EFFECT OF NEEM EXTRACT ON QUALITY OF FRUITS AND VEGETABLES

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Fruits and vegetable are known as protective food, as it provides minerals and vitamins. They have low shelf life and perishable early so to protect and to preserve the fruit and vegetable there is need of some coatings on the products but due to increasing awareness and preference of chemical free product among the consumer there is need to focus on plant based extract coatings. Plant extract are eco-friendly, have bioactive compound so prevent from the decay, insect-pest and disease and also plant extract are economically feasible. Neem (*Azadirachta Indica*) is a natural herb it have an active principal substance Azadirachtin it is known for its fungicidal, insecticidal and nematicidal properties. Neem extract come from seeds, leaf of the tree and have some traditional uses. Apart from Azadirachtin neem also have melantriol and saponins (Antimicrobial property). Azadirachtin have growth inhibiting effect against many insect-pest. It is basically plant consider as plant pathogen controller. Neem based extract such as seed/kernel, leaf used in many fruits. In guava with neem seed kernel extract prove to be repellent to the fruit fly. Neem extract is useful in controlling post-harvest disease and increase the activity of defense related enzymes in fruit. In apple neem seed oil have antifungal effect against *Botrytis cinerea* (Gray mold) and *Glomerellacingulata* (Bitter rot). Mango with neem leaf extract showed minimum decay, pH and loss in weight and maximum total sugars, ascorbic acid, acidity, reducing sugars and non-reducing sugars.

Keywords: Plant extracts, Azadirachtin, *Botrytis cinerea*, Melantriol

INDIAN AGRICULTURE: PROGRAMMES, INVESTMENTS AND GROWTH

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After 71 year of Independence, the share of agriculture in total national income declined from 50% in 1950 to 15.98% in 2018-19. But even today more than 50% of workforce is engaged in agriculture. In spite of this, agriculture that is to be noted that the growth of other sectors and overall economy depends on the performance of agriculture to a considerable extent. Given the importance of agriculture sector in Indian Economy, the Government of India has focused on offering schemes and incentives to various stakeholders. These schemes have helped the sector to improve foodgrain production, income and greater on-farm and off-farm job and livelihood opportunities of the farmers. Some of the major agricultural crops produced in India are rice, coarse cereals, pulses, oilseeds, sugarcane, cotton, jute and mesta. For this study a time period of around three decades was taken from 1992-93 to 2018-19. The Ministry has been allocated ₹57,600 crore in 2018-19. This allocation is 14.6% higher than the revised estimate for 2017-18. It is observed that the allocation under the Ministry increases suddenly due to the Interest Subsidy Scheme, which is being accounted under the Ministry of Agriculture from 2016-17, was under the Ministry of Finance earlier. Expenditure by the Departments of Agriculture, Cooperation and Farmers' Welfare and Agricultural Research and Education have been lower than their budget allocations in most years during the period 2009-18. Although the present expenditure was increased five times then the expenditure of 1992-93. This study also reflected that as the budget allocation increased in the period 2007-2016, there is a simultaneous growth in agriculture production and productivity.

Keywords: Budget allocation, Expenditure, Growth

FARM LEVEL ADOPTION OF SOIL HEALTH CARD AND ITS IMPACT ON RICE PRODUCTIVITY- A STUDY IN BISHNUPUR DISTRICT, MANIPUR

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Soils with poor health led to severe food and nutrient security problems like hunger and malnutrition in the world. The first step towards sustainable farming is using optimal doses of fertilizers and cropping pattern as per the scientific recommendation. On 5th December 2015 Soil Health Card Scheme was launched with an aimed to help farmers to improve productivity through judicious use of inputs. This paper examines the level of adoption of recommended doses of fertilizers based on soil test reports by the farmers and to analyse the impact of adoption of recommended doses of fertilizers on crop productivity in Bishnupur district of Manipur in the year 2019. A multistage purposive and random sampling method was used for the study to select 60 Soil Health Card users. Both the primary and secondary data were collected. Primary data were collected from the respondent farmers using pre-tested scheduled through personal interview method. From the analysis it was observed that out of 60 Soil Health Card Users 36.67 per cent are adopting recommended doses of fertilizers as per Soil Health Card and remaining 63.33 per cent are not adopting recommended doses of fertilizers. The results of the study revealed that respondents who are adopting recommended dose of fertilizers are experiencing better yield compared to those respondents not adopting recommend dose of fertilizers as per Soil Health Card. Therefore, the study suggests taking adequate measures by the policymakers to improve the performance of Soil Health Card. Government's subsidy on fertilizer should be given.

Keywords: Soil Health Card users, Soil Health Card non users, Manipur.

COVID 19: MEDICINAL HERBS CAN STRENGTHEN OUR IMMUNE SYSTEM

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Keywords: Medicinal Herbs, Immune System, Traditional Uses, Vitamin C

STUDIES ON SUSCEPTIBILITY OF BDR-10 AND DBV TO DIFFERENT PATHOGENS: INDICATING RESISTANCE BEHAVIOR IN BDR-10 AGAINST THE VIRUS

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Tropical tasar silkworm, *Antheraea mylitta* is wild silk-producing fauna in India. The silk derived from this silkworm is popularly known as Kosa Silk. The DABA Bivoltine (DBV) and Trivoltine (DTV) are commercially available races across India. Recently, a new race *i.e.* BRD-10 was developed through the selection of yellow larval type and authorized for commercial rearing. The yield parameter of BDR-10 was quite substantially promising compared to DBV in several places. To unravel the reason, a comparative field study was conducted to know the susceptibility of both DBV and BDR-10 for various disease. The overall mortality of silkworm due to different diseases was significantly less in the BDR-10 compared to DBV ($t=1.79$; $df=9$; $P=0.05$). The DBV race found succumbed to viral infection at all stages (instar). But, bacterial and fungal infection were recorded during and subsequent stages after third and fourth instar, respectively. BDR-10 larvae were susceptible to viral infection from third instar onwards. But, bacterial and fungal infections were recorded during and subsequent stages after the second and fourth instar, respectively. Calcium excretion symptom is a new type of disease of bacterial infection was recorded on fifth instar larvae of both DBV and BDR-10 races. A comparative study on mortality of larvae due to different infectious pathogens on fifth instar silkworm of both races revealed that the viral infection was significantly less in BDR-10 race compared to DBV ($t=3.19$; $df=9$; $P=0.005$). There was no significant differences in mortality between BDR-10 and DBV due to bacteria, fungus and calcium

excretion symptoms ($P>0.05$). Cocoon yield was significantly more in the BDR-10 during 1st and 2nd crop compared to DBV (1st crop: $t=1.95$, $df=15$; $P=0.03$ and 2nd crop: $t=1.84$, $df=15$; $P=0.04$). Our results suggest BDR-10 moderately resistance to viral infection compared to DBV.

Keywords: Tasar silkworm, Kosa Silk, Cocoon.

NANOTECHNOLOGY AS POTENTIAL TOOL AGAINST INSECT PESTS AND PATHOGENS

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Nanotechnology has revolutionized the world with tremendous advancements in many fields of science like engineering, biotechnology, analytical chemistry and agriculture. Nanotechnology would provide green and efficient alternatives for the management of insect pests and pathogens in agriculture without harming the nature. Their use in crop protection is just in its infancy. Nanomaterials measure approximately between 1 and 100 nm. A variety of metal nanoparticles silver (Ag), gold (Au), aluminum (Al), silica (Si) and zinc (Zn) and metal oxide-based polymers Zinc oxide (ZnO) and titanium dioxide (TiO₂) are being developed for crop pest and disease management. AgNPs have been used as effective biocides against a variety of pathogens, fungi and viruses. Application of nanotechnology in crop protection holds a significant promise in management of insects and pathogens, by controlled and targeted delivery of agrochemicals. Nanoparticles, nanoemulsions, nanosuspensions and nanocapsules have wider use as insecticides, insect repellents, herbicides and antifouling agents. The first microcapsule-based formulation became commercially available in the 1970s. The advantage of the use of nanoparticle insecticides includes the possibility of preparing formulations which contain insoluble compounds that can be more readily dispersed in solution. It reduces the problems associated with drifting and leaching, due to its solid nature, and leads to a more effective interaction with the target insect. Since there is no need for re-application, they also decrease the cost, reduce the irritation of the human mucous-membrane, the phytotoxicity, and the environmental damage to other untargeted organisms and even the crops themselves. Also, nanomaterial synthesised by utilizing functionalized metal nanoparticles as a sensing component offer several desirable features required for pathogen detection. Nanoparticles may act upon the pathogens as same as chemical pesticides or carrier of active ingredients of pesticides. Because of the ultra-small size, it may target virus particles and thereby open a new field of virus control in plants.

Keywords: Nanoparticles, insect pest management, pathogen detection

EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON THE LEAF NUTRIENT CONTENT OF AFRICAN MARIGOLD (*Tagetes erecta* L.)

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Marigold has become one of the most important crops in the country to be cultivated commercially for its loose flowers utilized in various occasions. An experiment was laid out with marigold variety, Summer Sugat at Andro Research Farm of Central Agricultural University, Imphal, during 2016-17. The experiment was laid out in Randomized Block Design with 11 treatments and each

treatments replicated thrice. The treatments consisted of 100 per cent RDN (Control) (T₁), 100 per cent N from FYM (T₂), 100 per cent N from vermicompost (T₃), 75 per cent N (Urea) + 25 per cent N (FYM) (T₄), 50 per cent N (Urea) + 50 per cent N (FYM) (T₅), 50 per cent N (Urea) + 50 per cent N (FYM) + *Azospirillum* (T₆), 75 per cent N (Urea) + 25 per cent N (Vermicompost) (T₇), 50 per cent N (Urea) + 50 per cent N (Vermicompost) (T₈), 50 per cent N (Urea) + 50 per cent N (Vermicompost) + *Azospirillum* (T₉), 25 per cent N (Urea) + 75 per cent N (FYM) (T₁₀) and 25 per cent N (Urea) + 75 per cent N (Vermicompost) (T₁₁). The results generated from the experiment showed that among the different treatments, treatment with 50 per cent N (Urea) + 50 per cent N (Vermicompost) + *Azospirillum*(T₉) recorded the maximum leaf N content (1.51 %), leaf P content (0.44 %) and leaf K content (1.33 %) and this was followed by the treatment of 50 per cent N (Urea) + 50 per cent N (FYM) + *Azospirillum* in the leaves of the marigold variety. The minimum nutrient content in the leaves was observed in the treatment of 100 per cent N from FYM (T₂) where leaf nitrogen, phosphorus and potassium content was recorded as 1.41, 0.19 and 1.08 % respectively.

Keywords: African marigold, *Azospirillum*, vermicompost, FYM

ASSESSMENT OF WEED MANAGEMENT TECHNIQUES ON PRODUCTIVITY AND PROFITABILITY OF RABI MAIZE

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The On-farm trial was conducted during *Rabi* season 2016-17 and 2017-18 for Assessment Of Weed Management Techniques On Productivity and Profitability of Rabi Maize at farmers fields of Munger district. The On-farm trial was conducted in randomized block design with three technical options *viz.* TO 1- Atrazine @1.0 kg a.i./ha as early post emergence at 7 days after sowing, TO 2 - Halosulfuron @67.5 g a.i./ha+ Atrazine@500 g a.i./ha as post emergence at 15 days after sowing and TO 3-Topramezone@40g a.i./ha + Atrazine@500 g a.i./ha as post emergence at 15 days after sowing and farmers practice (hand weeding at 25 and 45 Days after sowing) and keeping with 10 farmers fields(replications) of the Munger district. Application of Halosulfuron@67.5g a.i./ha+ Atrazine@500 g a.i./ha as post emergence at 15 Days after sowing was recorded significantly lower population of total weeds (11 and 9 m⁻²) and total weed dry weight (10.3 and 8.28 gm m⁻²) and at it was at par with Topramezone @ 40g a.i./ha +Atrazine@500g a.i./ha as post emergence at 15 Days after sowing during Rabi maize over farmers practice (total weed population 81 and 77 m⁻² and total weed dry weight 33.2 and 31.1 gm m⁻²) and Atrazine @1.0 kg a.i./ha as early post emergence at 7 days after sowing on 30 days after sowing of crop stage during both years of trials. Application of Halosulfuron @ 67.5g a.i./ha + Atrazine@500 g a.i./ha as post emergence at 15 days after sowing was recorded significantly higher grain yield (82.3and 85.1q ha⁻¹) and stover yield (101.03 and106.4 q ha⁻¹) and biological yield (183.33 and191.5q ha⁻¹) of rabi maize and at it was at par with Topramezone@ 40g a.i./ha +Atrazine@500 g a.i./ha as post emergence at 15 Days after sowing over farmers practice and Atrazine @1.0 kg a.i./ha as early post emergence at 7 days after sowing during both years. However, highest gross returns (Rs. 109947 and 119142 per ha), net return (Rs.73087 and 80342 per ha) and B:C ratio (2.98 and 3.07) was obtained with the application of Halosulfuron@67.5g a.i./ha+ Atrazine@500g a.i./ha as post emergence at 15 days after sowing followed by Topramezone@40g a.i./ha +Atrazine@500 g a.i./ha as post emergence at 15 Days after sowing, Atrazine @1.0 kg a.i./ha as early post emergence at 7 days after sowing over farmers

practice (gross return Rs.74409 and 73783 per ha, net return Rs. 33309 and 39078 per ha and B:C ratio 1.81 and 1.88) in rabi maize during both years of the on-farm trials.

Keywords: Weed Management, Productivity, Economics and Rabi Maize

INTEGRATION OF NUTRIENT SOURCES IN WHEAT (*TRITICUM AESTIVUM* L.) IN ARID REIGON OF WESTERN RAJASTHAN

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A field experiment was conducted during *rabi* seasons of 2014-15 and 2015-16 at agronomy farm of Swami Keshwanand Rajasthan Agricultural University, Bikaner to evaluate the effect of integrated nutrient management on wheat (*Triticum aestivum*L). Experiment was laid out in a randomized block design with three replications comprising 10 different treatment combinations *i.e.* control, 50%, 75% and 100% RDF, 50% RDF + FYM (5 t/ha), 75% RDF + FYM (5 t/ha), 100% RDF + FYM (5 t/ha), 50% RDF + FYM (5 t/ha) + *Azotobacter* + PSB, 75% RDF + FYM (5 t/ha) + *Azotobacter* + PSB and 100% RDF + FYM (5 t/ha) + *Azotobacter* + PSB. The wheat Raj-3077 was sown at 20 cm row spacing. FYM was applied in the field as per treatments and was thoroughly mixed 20 days before sowing of wheat seeds. The recommended dose of fertilizer for wheat was 120 kg/ha N, 40 kg/ha P₂O₅ and 20 kg/ha K₂O. Seeds of wheat were treated with *Azotobacter* and PSB in respective treatments at the time of sowing. Incorporation of 75% RDF + 5 t FYM /ha + *Azotobacter* + PSB in wheat, significantly increased all growth (CGR, RGR and others) & yield attributes, yield (4.12 t/ha) of wheat and nutrient (N, P, K) content in both grain and straw and protein content of wheat over control and other treatments, but remained statistically at par with 100% RDF + 5 t FYM /ha+ *Azotobacter* + PSB. Thus, 75% RDF + 5t FYM + *Azotobacter* + PSB in wheat should be applied throughout the *rabi* season, for better nutrient management and for getting better economic returns, as there is 25% savings of nutrients rather than 100% RDF + 5 t FYM /ha+ *Azotobacter* + PSB.

Keywords: CGR, Nutrient content, Protein content, RGR and Wheat.

EFFECT OF RHIZOBIUM AND PHOSPHORUS ON GROWTH AND YIELD OF MUNGBEAN (*Vigna radiata* L.)

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Mung bean (*Vigna radiata* L), commonly known as green gram, is an important pulse crop of India. It has the ability to fix atmospheric nitrogen (N) through *Rhizobium* species, living in nodules on its roots. The rate of nodulation is very low in most of the mung beangrowing area in India. Therefore, to study the influence of phosphorus (P) fertilization and *Rhizobium* inoculation on the nodulation, growth and yield of mung bean (*Vigna radiata*), a pot experiment was conducted in net house, during spring season of 2016 at ICAR-National Bureau of Plant Genetic Resources, New Delhi. Seeds of mung bean variety *PusaBaishakhi* were inoculated with *Rhizobium* and sown in pots containing 15 kg soil. Phosphorus was applied at 1.5, 2.5 and 3.5 g per 15 kg soil in each pot alone and along with inoculation of *Rhizobium phaseoli* except in control pot. The source of P was single

super phosphate that was mixed with soil before filling the pots. Recommended doses of N and K fertilizers were applied by using urea of 40 g per 15 kg soil (w/w) and MOP of 75 g per 15 kg soil (w/w) for the sowing, respectively. The experiment was laid out in 2 factorial completely randomized design with three replications. The pots were irrigated with fresh water, using sprinkler bucket in seven days interval. Plant height was recorded after 15 days of germination and at the time of maturity. After harvesting, length of roots, number of nodules per plant, number of pods per plant, number of grains per pod, weight of grains per plant and 1000-grain weight were recorded. The data collected for various characteristics were subjected to the analysis of variance. Results indicate that combined use of P and inoculant enhanced the number of nodules per plant. The maximum nodules, 8.70 per plant, were recorded where 3.5 g P along with *Rhizobium* inoculation was applied. Phosphorus application along with *Rhizobium* inoculation increased the plant height significantly (13.2%) over control. Maximum increase in plant height at maturity, total number of pods and number of grains per pod were also recorded where 3.5 g of phosphorus along with *Rhizobium* inoculation was applied. Phosphorus along with *Rhizobium* inoculation application increased plant height, total number of pods, number of grains per pod, and 1000-grain weight significantly. Maximum increase was noted where 150% of the recommended phosphorus along with *Rhizobium* inoculation was applied but it was statistically at par with the results obtained by applying 100% of the recommended phosphorus along with *Rhizobium* inoculation. Therefore, 100% of the recommended phosphorus along with *Rhizobium* inoculation is the best treatment in the experiment.

Keywords: Mungbean, growth, nodulation, phosphorus, inoculation

DEVELOPMENT AND STANDARDIZATION OF STEVIA INCORPORATED MULTIGRAIN COOKIES

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Cookies are most popular and widely consumed bakery product in India. Compared to conventional wheat flour cookies, the present investigation was undertaken on the utilization of finger millet, pearl millet, sorghum and flax seed for preparation of multigrain cookies. The gluten content and calorific value are less when compared to control cookies prepared using wheat flour, as millets are gluten free. The glycemic index of stevia is zero, which is useful for diabetic people when compared to sugar (high glycemic index). The cookies were developed by incorporating stevia powder to the flour mix containing high proportion of millet flour and low proportion of wheat flour (16%, 12.5% and 9%) in test samples. Shortening (low cholesterol butter), vanilla essence and baking powder are the other main ingredients used in preparation of cookies. On the basis of the scores in organoleptic evaluation conducted using 9-point hedonic scale, T2 cookies prepared using wheat (12.5%), finger millet (24%), pearl millet (25%), sorghum (26%), flax seed (12.5%) to which 6g of stevia added was standardized. The proximate composition of standardized cookies showed a mean percentage of moisture as 3.20±0.85, ash 2.24±0.12, fat 19.5±1.7, protein 12.5±0.85, crude-fiber 3.3±0.84 and carbohydrates 59.17±3.66 g/100g. This study indicates the prospects for utilization of millets, flax seed and stevia powder in preparing cookies with enhanced nutritional quality and sensory attributes.

Keywords : Cookies, Stevia, Gluten, Multigrain, Flax seed.

ROLES AND OPPORTUNITIES OF RUBBER PRODUCERS' SOCIETIES IN INDIA

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Natural rubber is an important agricultural product which is used in the manufacture of a wide range of products. Rubber plays a major role in the socio-economic fabric of many developing countries. India is the sixth largest producer and second largest consumer of natural rubber. India has one of the highest productivity among the major natural rubber producing countries despite not being a very favourable region for growing natural rubber. It has proved that with appropriate agro-management practices natural rubber can be grown as an economically viable crop in north east India. Tripura is the second largest producer and is considered as the second rubber capital of India, after Kerala. In India the rubber sector is dominated by small holdings. Small rubber growers were unorganised and processing of rubber was unscientific, which resulted in low quality product. In order to solve the political and bureaucratic control on rubber growers and to promote self-help concept, Rubber Board promoted formation of small voluntary associations of small growers at village level called the Rubber Producers Societies (RPS). Formation of RPS has improved the welfare of small rubber growers as RPS functions as a self help group which aims at the economic and social empowerment of growers. In India according to the recent estimates there are about 3000 numbers of RPS and 341 numbers in north east India.

Key words: Natural Rubber, North East India, Rubber Producer Societies, Rubber Board, Small Rubber Grower

NEGLECTED AND UNDERUTILIZED FRUIT CROPS - HOPE OF THE FUTURE

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Fruit crops like Mango, Banana, Guava, Papaya, Sapota, Apple, and Pear are widely growing fruit crops in India. They occupied nearly 75 percent of the total area under fruit cultivation. These fruits got commercial importance in growing because of the consumer preference of these crops due to distinctive flavour, aroma and taste. However, some fruit crops like Ber, Tamarind, Karonda etc, not gain commercial importance which are commonly called as underutilized fruit crops. With the rapid increase in the global population and fast depletion of available resources it is necessary to explore the underutilized fruit crops to meet the nutritional security. These fruit crops are rich source of carbohydrates, proteins, fats, vitamins, minerals and dietary fibers. They can easily grow in harsh climatic conditions and tolerant to pests and diseases. Some underutilized fruit crops have the distinctive aroma, flavour and taste, but there is improvement needed in yield and quality parameters by different breeding methods and popularization of these fruit crops among the people. These underutilized fruit resources can be used to combat malnutrition, hunger and to reduce the burden on overexploited fruits. Adaptation of new fruit sources will bring the unexploited underutilized and neglected plants into the mainstream of consumption.

Keywords: Tamarind, Adaptation, Malnutrition, Underutilised Fruit Crops

STUDIES ON EFFECT OF DIFFERENT PRE-SOWING TREATMENTS ON SEED GERMINATION OF KAGZI LIME (*Citrus aurantifolia* Swingle.)

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The present investigation was carried out at Department of Horticulture, College of Agriculture, Badnapur, Jalna, VNMKV, Parbhani. With a view to study the effect of different growth regulators and chemicals on seed germination of Kagzi lime. The experiment was laid out in Randomized Block Design with thirteen treatments replicated thrice, comprising three treatments of GA₃ concentrations *i.e.* (40, 60 and 80 ppm), three treatments of NAA concentrations *i.e.* (40, 60 and 80 ppm), three treatments of KNO₃ concentrations *i.e.* (1.0, 2.0 and 3.0 %), three treatments of Thiourea concentrations *i.e.* (0.5, 1.0 and 1.5 %) and control (Distilled water). The results of the investigation revealed that, there were significant variations in germination of Kagzi lime due to pre-sowing treatments. Amongst the different treatments, the seed soaked in GA₃ 80 ppm solution for 12 hours prior to sowing resulted in maximum germination percentage (95.00 %) and significantly more average number of seedlings per seed (2.27).

Key Words: Growth regulators, Chemicals, Germination, Kagzi lime

PADDY STRAW PLA-PER (PLANTABLE PAPER): A GREEN ECONOMY INNOVATION

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Over 65% of Indian population depends on rice as their staple food. Farmers mostly dispose the paddy straw by burning as it is seen as the most cost-effective measure to get rid of the residue. However, winter burning of paddy straw has resulted in the formation of deadly “toxic cloud” in Delhi and the neighbouring states. Paddy straw is unpalatable as a feed for cattle. At the same time, its higher ash content hinders its use in biofuel production. Hence, it is extremely crucial to find an alternative use for paddy straw which would be an additional revenue for the farmers cultivating paddy. As paddy straw has higher cellulose and lower lignin content, it is best suited for paper production. Using a renewable and sustainable technology, the paddy straw is replenished as plantable paper which is reborn as plant when discarded in the soil after use. The pulp production involves simple processes like cutting, soaking, rinsing, cooking, beating which is done using natural solvents like wood ash lye. The seeds are incorporated in the pulp, strained and moulded to finally obtain the plantable paper. The seeds chosen are of shorter germination period and longer viability like basil, hollyhock, marigold, tomato and parsley. Thus, the seed imbibed papers can be used in packaging industry like cardboards, paper pouches that are often used for a limited time period and then discarded. This sustainable paddy straw plantable paper proves to be a mitigative measure for stubble burning as well as additional revenue to the farming community.

Keywords: Paddy straw, Burning, Sustainable technology, Plantable paper, Revenue.

EVALUATION OF YIELD PERFORMANCE OF LENTIL (*Lens culinaris linn*) THROUGH CLUSTER FRONT LINE DEMONSTRATION IN DARBHNGA DISTRICT OF BIHAR, INDIA

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Bihar one of the important pulses growing and consuming state in India contributes about 2.35 percent of area which is 7-8 percent of the gross cropped area in the state and 3.06 percent of production. The productivity of pulses range between 819 kg/ha in 2000-01 to 897 kg/ha in 2013-14. It is mostly grown in rain fed condition and resulting in high yield fluctuation every year. In India average yield of pulses in rice fallow system is about 11% higher than national average, whereas in Bihar it is higher than 30% and in Madhya Pradesh by 15% Traditionally pulses have been considered important elements of cropping systems in the Bihar, but with the introduction of irrigation and high profitability of alternative sources of soil nutrients in the form of inorganic fertilizers in 1960s, pulses were replaced or relegated to marginal lands and were substituted by high-yielding varieties of rice and wheat. Pulses, an important constituent of food grains, play a vital role in food and nutritional security of millions of down trodden people of the world. Being an important source of protein, poor people mostly depends on pulses for meeting their daily requirements of this essential nutrient. Pulses will form a major source of protein for a huge section of Indian particularly, for the poor, backward classes of the traditionally vegetarian population (Reddy, 2004). But in reality, the net availability of pulses has come down from 61 to 37 gm/day/person and daily per capita consumption has come down from about 74 grams to 23 grams during the period 1960-61 to 2009-10 as against the ICMR norms of 40 gm/day/ person over the period 1950-51 to 2008-2009 in India. The data outputs were collected from both CFLD plots as well as control plots (farmers practices) and finally the extension gap, technology gap, technology index along with the benefit cost ratio. The result of Cluster Front Line Demonstrations convincingly brought out that the yield of lentil could be increased by 21% to 64.35% with the intervention of balanced nutrient coupled with the improved seed and disease management in the Darbhanga district of Bihar. The input and output prices of commodities prevailed during each year of demonstration were taken for calculating cost of cultivation, net return and benefit cost ratio. From the above finding, it can also be concluded that use of scientific methods of lentil cultivation can reduced the technology gap to a considerable extent thus leading to increased productivity of the district. Moreover, extension agencies in the district need to provide proper technology support to the farmers through different educational and extension methods to reduce the extension gap for higher pulses production in the Darbhanga district of Bihar.

Keywords: Yield gap, Extension gap, Technology gap, Technology index, CFLD, Pulse, B:C:R

FORAGING BEHAVIOUR OF POLLINATORS AND EFFECT OF POLLINATOR ATTRACTANTS ON SEED QUALITATIVE AND QUANTITATIVE PARAMETERS IN OKRA

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A study was conducted to know the foraging behaviour of pollinators in okra flowers and the effect of pollinator attractants on seed qualitative as well as quantitative parameters at ICAR-IIVR-Regional Research Station, Kushinagar during Kharif 2019. Different pollinators visiting okra cv. Kashi Chaman flowers during peak flowering period were recorded and their activity was studied. Pollinators visit was studied at different time interval i. e. from 7-8 am, 9-10 am and 11 am-12 pm. Effect of pollinator attractants was studied by spraying different pollinator attractants at weekly intervals starting from 10 % of flowering. Ants were the major flower visitors followed by lepidopteran insects mainly *Pelopidas* spp. *Papiliopolytes*, *Udaspesfolus* followed by *Apis* species mainly *Apis cerana indica* and *Apis florea*. Least visits were recorded for dipteran insects and coleopteran insects in okra. Okra flowers were open for pollination in between 6.00 am-12.30 pm. Pollinator's major activity was observed from 9-10 am followed by 11-12 pm and then least activity was observed in 7-8 am. In pollinator attractant experiment, significantly higher activity of pollinator's was observed in the treatment 5% sugar+5% jaggery+50ppm boron followed by 5% sugar+5% jaggery. Relatively less pollinator activity was observed in the treatment 5% sugar solution and open pollination. A combination of 5% sugar+5% jaggery+50ppm boron significantly enhanced the seed yield and seed quality parameters like number of pods per plant (8.1), pod length (15.7cm), number of seeds per pod (50.2), seed yield per plant (20.83g), seed yield per plot (2.49kg), total seed yield (15.59q/ha), enhanced seedling length (22.1cm), dry weight (24.4 mg per seedling), vigour index I (1956) and vigour index II (2168). No significant difference in 100 seed weight and germination (%) was observed. Though pollen load was high in hand pollination, it didn't show significant enhancement in seed yield. Thus, in conclusion, ants, lepidopteran moths and *Apis* species were the major flower visiting insects whose peak activity was observed in 9-10 am. To enhance the seed qualitative as well as quantitative parameters 5% sugar+5% jaggery+50ppm boron spray is effective.

Keywords: okra, pollinator attractants, seed qualitative and quantitative traits

FIELD BIOEFFICACY, RESIDUE AND SAFETY EVALUATION OF CHLORANTRANILIPROLE IN OKRA FRUITS

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Okra (*Abelmoschus esculentus* (L.) Moench.) is an economically important major vegetable crop grown extensively across the Indian subcontinent. More than 37 insect pests are reported to infest okra crop during its growth period from germination till harvest. Among these, fruit borer, *Earias vittella* (Fabricius) is one of the major limiting factor in okra cultivation as it causes significant fruit damage. The field experiment was conducted to evaluate the bioefficacy of different novel insecticides and residue persistence of chlorantraniliprole 18.50 SC residues in okra fruits. Among various treatments, chlorantraniliprole tested at 30g a.i. ha⁻¹ found most effective in reducing fruit damage by *E. vittella* larvae as well as sucking pests infestation with a significantly

higher marketable fruit yield recorded under open field conditions. Chlorantraniliprole caused 92% (on number basis) and 96% (on weight basis) reduction of fruit damage over untreated control after three rounds of insecticide spraying and found significantly superior over rest of the treatments. It was also observed to be safe to the natural enemies found in the okra ecosystem. Chlorantraniliprole residues were extracted from okra fruit matrices with ethyl acetate and cleanup was given by using primary secondary amine (PSA) and magnesium sulfate. The limit of quantification (LOQ) was estimated to be 0.01 mg kg⁻¹ and average % recoveries ranged from 83.67 to 89.00. The half-life was estimated 1.72 days. The residue analysis revealed that the residues in okra fruit were below the maximum residue limit (0.6 mg kg⁻¹) after 1.10 days of the last spray. Dietary exposures of the residues on each sampling day based on the average daily consumption were less than the maximum permissible limit (MPI). Therefore, based on field bioefficacy and residue status, chlorantraniliprole 30g a.i. ha⁻¹ can be used in okra ecosystem to manage sucking pest complex and fruit borer effectively without any health hazard.

Keywords: bioefficacy, chlorantraniliprole, residue, safety, okra

EVALUATING CALCAREOUS SOIL RESISTANCE FOR SEEDLING EMERGENCE

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The current work aims at evaluating the resistance of calcareous soil for seedling emergence in-site. Due to the differentials in surface crust morphology and properties causing difficulties in observing a finite crust of measurable thickness, evaluation by Modules of Rupture (MR) and Penetration Resistance (PR) became inappropriate and replaced by determining the value and depth of maximum soil resistance for germination at sowing depth (GR_{max}), and soil surface resistance for cracking (GR_c). The recently reclaimed calcareous soils, northwestern coast, Egypt had been chosen for this investigation, soils were taken from the 0-30 cm surface layer, representing 3 textural classes: clay loam, loam, and sandy loam, and three CaCO₃ contents: 250-300 g kg⁻¹, 300-350 g kg⁻¹, and > 400 g kg⁻¹. Soils were packed into stainless steel pots with dimensions of diameter and 20 cm height 15 cm exposed to three main artificial rainstorms 60 mm 30 min⁻¹, 120 mm 30 min⁻¹, and 180 mm 30 min⁻¹ for two different durations 10 and 30 min with two sloping grades 9 and 2%. Soil pots were oven-dried at 30°C for 2, 4, and 7 days. A new tool called "Germiometer" had been designed and used for measuring soil resistance for germination (GR_{max}) and surface crust resistance for cracking (GR_c) at the topsoil layer (0-5 cm). Soil moisture content was determined after each measuring, while soil bulk density was determined after day 7. GR_{max} was affected negatively by soil moisture content more than soil compaction, this relationship between GR_{max} and moisture content was negatively correlated with soil depth. the depth of (GR_{max}) point was varied between 5-4 and 3-2 cm with values ranged between 0.91 and 7.63 MPa at a moisture content between 62.18 and 17.31% of soil field capacity. The severity of soil resistance on seedling emergence varied between slight to extremely severe. The point of maximum soil surface resistance for cracking was found at depths varied between 1-0 and 4-3 cm with values ranged between 0.48 and 3.75 MPa at a moisture content between 74.22 and 17.12% of soil field capacity. The severity of soil surface resistance for cracking varied between slight to sever. Planting depth could be the major impedance for seedling emergence, under northwestern coast area conditions planting depth not to exceed 3 cm at moisture content between 45 - 75% of the field capacity.

Keywords: Crust Induced Rainfall, Calcareous Soils, Soil Degradation

SELECTION OF GENOTYPES FOR DROUGHT TOLERANCE BREEDING BASED ON BIOMETRICAL TRAITS IN BRASSICA SPECIES

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Thirteen genotypes belonging to five species *Brassica rapa*, *Brassica juncea*, *Brassica carinata*, *Brassica napus* and *Eureca sativa* were evaluated to study the diversity among the genotypes and to identify the desirable and potential parent in mustard breeding programme for drought tolerance at College of Agriculture Nagpur. The analysis of variance and analysis of dispersion revealed highly significant differences among the genotypes for the traits studied viz. days to 50% flowering, days to maturity, plant height, number of primary branches, number of silique per plant, 1000 seed weight and seed yield per plant. Thirteen genotypes grouped into five clusters by D² analysis. The maximum intercluster distance was recorded between cluster IV and cluster III. The canonical analysis indicated the importance of character like number of silique, days to maturity, days to 50% flowering and seed yield per plant towards the source of variation. Drought tolerant genotype RTM-314 and T-27 deviated from all other genotypes on the basis of genetic markers uniqueness for drought tolerance as compared to other genotypes. The results of the study lead to conclusion that the cultivated genotype ACN-9 and Pusa Bold of *Brassica juncea* can be further improved for earliness by crossing with Ragini and Bhavani (*Brassica rapa*) and by crossing with RTM-314 and T-27 (*Eureca sativa*) for drought tolerance.

Key words: Mustard genotypes, biometrical traits, D² analysis

FISH FARMING AS AN INNOVATIVE STRATEGY FOR PROMOTING FOOD SECURITY AND LIVELIHOOD STATUS OF TRIBAL FISHERMEN AFTER IMPLEMENTATION OF TRIBAL SUB PLAN (TSP) IN DIFFERENT BLOCKS OF PURULIA DISTRICT

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Fishing is one of the oldest means of livelihood of mankind and fisheries sectors play an important role in the national economy and in the socio-economic development of in India. West Bengal is one of the leading fish producing states in the country and the largest producer of fish seeds in the country. Fishery-related livelihoods are complex, dynamic and adaptive. The study was conducted to investigate the socio-economic condition, livelihood status and comparative study of the fishermen around the two blocks of purulia district from February 2017 to July 2017. Fifty fishermen were randomly selected from the areas who were solely involved in fishing in the rivers. Several PRA tools were used to collect the data from the fishing communities such as, personal interview, crosscheck interview with extension agents, older persons, and transect walk and case study. A Comparison in the livelihood status specially in the economic upliftment was carried out in the tribals of Purulia district. The growth patterns and the relationship among the different input variable was under study in both cases that is before adoption of Tribal Sub Plan and after enjoying Tribal Sub Plan to judge whether there is any significant different between the two. For the socio economic upliftment of tribal people, Tribal Sub Plan (TSP) was formulated and adopted in different districts. From the research work carried in the district of Purulia it clearly shows a positive impact upon the culture and subsequently to the farmers.

Key Words: Statistical modeling, Tribal Sub Plan, Tribal Fisher folk, correlation, Economic Upliftment

HYDROPONIC STRAWBERRY PRODUCTION—A SOIL FREE WATER SAVING TECHNIQUE FOR QUALITY PRODUCE

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Hydroponics is the technique of growing plants in a water-based, nutrient-rich medium, without the use of soil. This method essentially cuts down the amount of water being used compared to the method in which plants are grown in soil. Strawberry (*Fragaria x ananassa* Duch.) is one of the most popular fruits around the world due to its highly desirable taste and flavour. The increased demand for strawberries throughout the year is met through Hydroponic cultivation. In some cases, up to 90 percent less water is used in the hydroponics method compared to the traditional soil-based agriculture — a boon for water-starved urban areas. One can plant four times the number of crops in the same space as soil farming. Hydroponic culture Verti-Gro system for growing high value crops has been in commercial practice in countries like United States of America, Japan, Australia and Italy. Hence, it is important to find the most suitable soilless cultivation system for strawberry to maximize the utilization and distribution of light and culture media within the system to enhance production without affecting the fruit quality. Keeping all these benefits and constraints in view, the present investigation was carried out to study the growth, yield and quality of strawberry cultivated in vertical growth system with soilless media in a vertical hydroponic system established by the JNKVV, Krishi Vigyan Kendra, Chhindwara, Madhya Pradesh. Healthy plugs of strawberry were planted in vertical growth system. Significant differences were observed for the growth parameters, viz., number of leaves, flowering and fruiting, No. of fruits, fruit weight, fruit diameter, leaf area, crown diameter and production per plant.

Keywords: hydroponics, growth, strawberry, fruit quality, vertical, yield

EFFECT OF EXOGENOUS APPLICATION OF SALICYLIC ACID ON ANTIOXIDATIVE ENZYMES AND YIELD ATTRIBUTES UNDER SALT STRESS IN *Sorghum bicolor* L.

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Little is known on the impact of salicylic acid in sorghum under salt stress, its toxicity is a worldwide agricultural and eco-environmental problem. Seeds of sorghum genotypes (HJ 513 and HJ 541) were grown under four different salt levels (0, 5.0, 7.5 and 10.0 dS m⁻¹ NaCl) and three salicylic acid, SA (0, 25 and 50 ppm) levels with twelve different combinations. Limited water availability hampers the sustainability of crop production. Assessment of the specific activities of the superoxide dismutase, catalase and peroxidase under salt stress increased 41.1 %, 122.0 % and 72.8 % in HJ 513 respectively in leaf sample at vegetative stage and over all seed yield and yield attributes i.e. panicle length, panicle weight, seed yield per plant, 100 seed weight and harvest index reduced significantly under salt stress. Furthermore, one of yield attributes i.e. seed yield per plant was ranged from 13.2 to 9.7 in HJ 513 and 11.9 to 8.7 in HJ 541 at 10 dS m⁻¹ of salt stress. Under stressed in concomitance with un-stressed crop showed significant results after added salicylic acid, which further increased the antioxidant enzymatic activity and increase the yield attributes and yield in sorghum. The results of the present experiment coincided with the conclusion that SA may be involved to ameliorate the adverse effect of salt stress on sorghum crop.

Keywords: Antioxidant, Salicylic acid, Sorghum

**GOVERNMENT INITIATIVES AND POLICIES FOR ENTREPRENEURSHIP
DEVELOPMENT
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In India, entrepreneurship can be one of the most important venture to addressing the problems of unemployment and poverty. The development of entrepreneurship is an essential part of the economic development of our country. Government take various steps to mitigate the unemployment challenges from time to time. The government of India has a number of effective schemes for the development of entrepreneurs in rural as well as urban area. Entrepreneurial development programmes may be defined as a programme designed to help an individual in strengthening his entrepreneurial motive and in acquiring skills and capabilities necessary for playing his entrepreneurial role effectively. By setting up of Entrepreneurship Institutions, organizing Entrepreneurship Development Programmes (EDPs) and various Government Programmes and Schemes for the promotion of entrepreneurship one can realize his/her own potential. Most of the developing country needs entrepreneurs to initiate the process of development, create entrepreneurial opportunities to sustain it. In the present Indian context, where on the one hand, employment opportunities in public sector and large-scale sector are shrinking, and on the other, vast opportunities arising from globalisation are waiting to be exploited; entrepreneurship can really take India to the heights of becoming a super economic power. Entrepreneurship has acquired central importance among the processes that affect economic change. The government of India has several effective schemes for the development of entrepreneurs.

Keywords: Entrepreneurship, Entrepreneurship Development, Entrepreneur.

**MOLECULAR MARKERS IN PLANT BREEDING, ADVANCEMENTS IN GENOMIC
SELECTION AND GENOME EDITING**

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With the development of molecular marker technology in the plant breeding, the fate of plant breeding has changed. Different types of molecular markers have been developed and advancement in sequencing technologies has geared crop improvement. The progress made in molecular plant breeding, genetics, genomic selection and genome editing has contributed to a more comprehensive understanding of molecular markers and provided deeper insights into the diversity available for crops and greatly complemented breeding programs. Genotyping-by-sequencing and association mapping based on next-generation sequencing technologies have facilitated the identification of novel genetic markers for complex and unstructured populations. CRISPR is a genome-editing technique applied successfully in various plants. Cas9 is a recent advancement in the genome-editing technology and is becoming the technique of choice due to its many advantages, like its being easy to use, genome-editing versatility and ability to cleave methylated loci CRISPR technology has revolutionized the plant breeding and genetics and researchers are focusing on editing the genomes of all economically important plants. Plant Breeder Ultimate goal is to enhance the economy of farmer, due to reducing in field and enhancement of population it is very necessary to use various technologies for enhancement of crop yield.

Keywords:genomic selection, genome editing

OPTIMIZATION OF GROWTH CONDITIONS FOR PHOSPHATE SOLUBILIZING PLANT GROWTH RHIZOBACTERIA ISOLATED FROM RICE RHIZOSPHERE IN INCEPTISOLS

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An experiment was conducted to optimize growth conditions for phosphate solubilizing rhizobacteria isolated from rice rhizosphere of different regions of Jammu district. Phosphate solubilizing rhizobacteria (PSRB) were isolated from soil by serial dilution method maintained on nutrient agar which was further subcultured on selective medium to obtain pure cultures. The pure cultures thus obtained, were optimized at different pH, (5.5, 6.5, 7.5 and 8.5), temp. (28, 33 and 37°C) and salt concentration (1.0, 1.5, 2.0 and 2.5). Phosphate solubilization of the isolates was estimated both by qualitative and quantitative method. Among the selected isolates PSB 1 showed its maximum growth at pH 6.5, salt conc 1.5% and at temp 33°C whereas PSB 2 showed its maximum growth at pH 7.5, salt conc. 2% and at temp 37°C. Qualitative phosphate solubilization in the form of halo zone diameter was found extending upto 8mm of PSB 1 followed by its quantitative solubilization which amounts to 3.86µg/ml upto 5th day in comparison to 2.86µg/ml in control. PSB 2 has its halo zone extending upto 3mm followed by its quantitative solubilization which amounts to 4.86µg/ml upto 5th day in comparison to 2.86µg/ml in control. Thus based on these parameters these isolates can be used for plant growth promotion rhizosphere (PGPR) activities for soil and plant as well.

Keywords: Rhizosphere, Phosphate solubilizing rhizobacteria, Phosphate solubilization, PGPR activities

THE ROLE OF MEDICINAL HERBS AND SPICES TO BOOST UP THE HUMAN IMMUNITY FOR COMBATING COVID-19

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A novel coronavirus (Covid-19) of Severe Acute Respiratory Syndrome (SARS-CoV-2) originating from Wuhan city of China in December/2019 has spread in more than 20 countries across the world as pandemic in nature showing flue type symptoms in patients like dry cough, cold, high fever, headache, sneezing, sore throat, short breathing, pneumonia, weakness, vomiting, loss of appetite & health declared by WHO as a deadly disease for human. Due to Covid-19, 27.352 million people were infected, 18.348 million were recovered and 0.893 million were died in the world; whereas in Bangladesh, 329251 were affected, 227809 were recovered and 4,552 were died, reported on 7 September, 2020 (www.corona.gov.bd/). The people older than 60 years or having health problems i.e. heart disease, diabetes, respiratory diseases (asthma, COPD, bronchitis, lung cancer, cystic fibrosis, pneumonia etc.) and lower immunity are highly susceptible. There is no vaccine/drug developed successfully yet but some countries (Russia, USA, China etc.) are trying which will be

very costly for Bangladesh. So, prevention and management are the best options. So, the augment of immunity stronger against Covid-19 and other diseases is important. Different factors like imbalanced diet, excessive alcohol intake, irregular sleep, high stress, obesity, dehydration, chronic medications decrease our immunity. More than 80 spices mostly ginger, garlic, turmeric, black pepper, cinnamon, cloves, cardamom, bay leaf, black cumin, coriander, saffron, onion, fenugreek etc. having health benefits were grown in the world. A well balanced diet, physical exercise, spices in meals, detox plans (fasting), consumption of ayurvedic herbs like Tulsi, Mint, Neem leaves, Ashwagandha, Giloyare said to have several health benefits. The ayurvedic remedies i.e. tea (ginger, cloves, cinnamon, black pepper, cardamom, fenugreek boiled water) with honey at morning cleanse the respiratory tract; turmeric and black pepper in daily meals; minimized intake of red meat or any processed meats; intake amla juice; drink plenty of warm water to strengthen immunity in body. Take the ayurvedic herbs, spices, vegetables and fruits regularly, and be stress free along with high immunity to combat Covid-19.

Keywords:SARS, Ayurvedic plants, Spice, Respiratory diseases, Covid-19

STANDARDISATION OF TISSUE CULTURE PROTOCOL OF DWARF PAPAYA (*CARICA PAPAYA* L.) VARIETY PUSA NANHA SUITED FOR HIGH DENSITY PLANTING

BINDU B

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Papaya is slowly emerging from the status of a homestead crop to that of commercial crop due to increasing awareness of multifold uses of papaya. Its cultivation is encountered with the problem of its dioecious nature. Micro propagation represents the only economic way of continuously producing uniform planting materials of known sex. The studies on “*In vitro* propagation of papaya (*Caricapapaya*L.)” was carried out at the Department of Pomology and Floriculture an, College of Agriculture, Vellayani. The propagation studies were carried out by enhanced release of axillary buds in Papaya variety PusaNanha. Apical buds and lateral buds from seedlings and mature plants were used as explant. Explants were subjected to different treatments of plant growth substances for culture establishment and shoot proliferation. . In order to standardise a suitable hormone combination for better culture establishment, studies were carried out using BA, Kinetin and NAA at various concentrations. The treatments involved were different levels of cytokinins, viz; BA (0.20 -5.00 mg l⁻¹) and Kinetin (0.50-5.00 mg l⁻¹) alone or in combination with auxin, viz., NAA (0.01, 0.10 and 0.50 mg l⁻¹). Six replications were kept for each treatment. The study revealed that full strength MS medium supplemented with sucrose 30.00 g l⁻¹ and agar 6.50 g l⁻¹ under light condition produced highest shoot number and longest shoot in papaya. Application of BA 0.50 mg l⁻¹ along with NAA 0.10 mg l⁻¹ was found to be better for initial culture establishment and proliferation. Application of amino acid, glycine, 100.00 mg l⁻¹ resulted in highest shoot proliferation rate, while highest shoot length was obtained from arginine 100.00 mg l⁻¹. Addition of activated charcoal 0.05 per cent and Cobalt chloride 5.00 mg l⁻¹ increased the shoot proliferation rate and shoot length in papaya. *In vitro* rooting was more in full strength MS medium supplemented with IBA 3.00 mg l⁻¹, sucrose 30.00 g/l and activated charcoal 0.05 per cent.

Keywords :Papaya, Micropropagation , Explant, Medium, Shoot proliferation

EFFECT OF DIFFERENT HERBICIDES ON WEED DYNAMICS AND PRODUCTIVITY OF CHICKPEA (*Cicerarietinum*)

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A field experiment was conducted at BAU farm, Sabour, Bihar, India during 2019-20 to evaluate the effect of herbicides on weed dynamics and productivity of chickpea. Ten treatments consisted with eight herbicidal treatments, pre-emergence application of pendimethalin 1000 g/ha, oxyfluorfen 150 g/ha; post-emergence application of quizalofop-ethyl 50 g/ha, imazethapyr 50 g/ha, propaquizafop 25.2 g/ha, topramezone 40 g/ha individually and two of different herbicidal combinations as imazethapyr + imazamox (Readymix) 60 g/ha (PoE) and clodinafop-propargyl + na-aciflurofen (Readymix) 220 g/ha (PoE) along with two hand weedings at 30 & 50 DAS and weedy check, were tested in randomized block design with three replications. Two hand weedings recorded significantly reduced weed density and weed dry matter at 60 and 90 DAS with WCE of 91.73 & 93.60 % at 60 & 90 DAS respectively and was similar to use of topramezone 40 g/ha. Post-emergence application of topramezone (40 g/ha) resulted in maximum plant height (54.22cm at harvest), number of branches/pant (21.77), number of pods/plant (48.86), test weight (21.62g), grain yield (1.63 t/ha), gross return (Rs. 79,560/ha), net return (Rs. 47,404/ha) and B:C ratio (1.47) compared to other herbicide applications. So, the application of topramezone as post-emergence (40 g/ha) was as good as two hand weedings (At 30 and 50 DAS) for better weed control, higher crop yields and benefits.

Keywords: Chemical control, hand weeding, herbicide combination, weed control, efficiency, chickpea.

NUMERICAL AND STRUCTURAL CHROMOSOMAL CHANGES IN MEDICINALLY IMPORTANT *Viola* AND *Allium* SPECIES AND THEIR IMPACT ON FERTILITY

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Jammu Province, exhibiting marked altitudinal and geographical variations, is a hub of medicinally important genera like *Allium* and *Viola*. While *Allium* species, containing anti-microbial components, are largely used for seasoning dishes, species of *Viola* (commonly called Banafsha) are used to cure cough and cold. In Jammu region, genus *Allium* is largely represented by cultivated *Allium cepa* and wild *Allium roylei* and genus *Viola* by *V. pilosa*. Present cytological studies in a population of *A. cepa* from Kiharian village revealed somatic complements of its plants uniformly containing diploid number of chromosomes ($2n=16$). These, however, possessed 15% pollen mother cells (PMCs) with 16 plus 1-4 chromosomes. These plants were further in having 12.5% chromosomes associating as multivalents. The other *Allium* species viz. *A. roylei* also contained PMCs with multivalents which, however, were very complex and involved up to entire genome. Presence of these meiotic anomalies resulted in very low pollen viability and sterility. Like *Allium* species, multivalents have also been witnessed in *V. pilosa* which also adversely affected pollen viability and fecundity of this species.

**INNOVATIVE APPROACHES IN INDIA FOR DOUBLING FARMERS INCOME
THROUGH AGRICULTURE AND ALLIED ACTIVITIES**

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Income is the most relevant measure to assess farmers' economic well being and sectoral transformation. The crises and distresses plaguing the sector endanger the very livelihoods and welfare of the farmers. Indian Government with the intention giving enough policy thrust on income security, proposed to double the farmers' income by 2022, platinum jubilee year of the Indian independence. The challenges faced by the farming community in the coming years have been highlighted for devising relevant pathway and strategies to enhance the income. Yield enhancement followed by cost reduction, fair price realisation and risk adaption has been identified as the potential pathway for doubling income. In the event of pursuing sustainable agriculture, food security, rural employment, and environmentally sustainable technologies are essential for holistic development. Indian agriculture and allied activities have witnessed a green revolution but in the years to come challenges to agriculture will continue to increase because large population is to be fed from declining land and water, in the scenario of climate change. It is well known that more than 58% of the rural households is dependent on agriculture, thus primary focus of the government has been on rural development to improve the livelihood of rural people. It is also evident that good rains can only help in the short run, but long term solutions are needed through water saving infrastructures and technologies. Some of the recent achievements have been possible due to spirit of our farmers, their hard work even in adverse conditions and in countable initiatives of the Government of India, like, National Food Security Mission, Rashtrya Krishi Vikash Yojna, Mission for Integrated Development of Horticulture as well as several research initiatives but the increase in production can only come from increase in productivity. Our productivity and income levels can be substantially increased by better use of technology and adoption of newer method. To achieve this target of doubling of farmers income by 2021-22, this Department has constituted a Committee under the Chairmanship of Additional Secretary (Policy) to examine issues relating to doubling of farmers' income by year 2021-22. The Government of India has taken appropriate measures to increase farm income, stabilize production and, consequently, improve small farm productivity. Increasing availability of quality seeds and planting material for adoption of high yielding varieties and hybrids, Integrated Farming System, Water use technology for high efficiency. Branding of Indian food and agri produce for export promotion, Post-harvest management for reducing post-harvest losses (Food saved is food produced), Covering risk through crop insurance will bring stability in farm income. Farmers' income can be improved when productivity goes up, cost of production comes down, if agricultural commodities produced get a remunerative price through a transparent price discovery mechanism.

Keywords: Farmers, Doubling income, Productivity

ESTIMATING GENE ACTION AND COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD ATTRIBUTING TRAITS IN SESAME (*Sesamum indicum* L.)

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Sesame (*Sesamum indicum* L.) is an important kharif oilseed crop of Jharkhand mostly grown under rainfed condition. Sesame seeds contain about 50-60% oil and it is considered as the queen of high quality vegetable oils. It harbours wide array of phytochemicals (in seed) with antioxidant, antifungal, hypolipidaemic and hypoglycemic properties. The aim of the study was to estimate gene action, identify and select superior parents and best hybrid combinations on the basis of estimates of general and specific combining abilities for yield, its related traits in sesame. Twenty eight offspring were synthesized by crossing of eight diverse parents in a diallel scheme excluding reciprocals during rabi 2017-18. These 28 crosses along with eight parents were sown in rabi 2018-19 in randomized block design with three replication at Zonal Research Station, Chianki, Palamu. The differences among genotypes were highly significant for all the characters studied. Estimates of variance due to general combining ability (gca) and specific combining ability (sca) and their ratio revealed that both additive and non-additive gene effects were important for different characters studied. The estimates of gca effects as a whole suggested that if most of the traits are to be improved through hybridization and selection, then priority should be given to parents PKVNT-11 and Kanke White. The estimates of specific combining ability revealed that the crosses JTS-8 x Shekhar, PKV-NT-11 x Kanke White and JLT-408 x Shekhar were the best specific combiner for seed yield per plant. The above cross combinations may be useful for genetic improvement of seed yield of the crop.

Keywords: Sesame, gene action, general combining ability, specific combining ability

CRISPR/Cas: A PRECISE TOOL FOR CROP IMPROVEMENT - A Review

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CRISPR/Cas mediated genome editing system is a recent emerging plant breeding tool for crop improvement which is a natural adaptive immune mechanism in bacteria. A single guide RNA along with the suitable Cas protein molecule can be used for targeted mutagenesis to prevent gene expressions and also to insert desirable genes. It has high versatile procedures to produce desirable results. This precise method has been used for studying plant functional basics and enhancing morphological traits, quantity, quality, resistance to biotic and abiotic stress and to create genetic variability in many field and horticultural crops. Here, we describe about its origin, applications in crop improvement and contribution to food security. This controlled genome editing is safer than the conventional method of radiation mutagenesis and the genetically modified crops. It must be used along with conventional breeding techniques to create desirable genotypes rapidly, saving time and resources. This method can be considered under sustainable solution for providing food security. Key words CRISPR/Cas, Genome editing, sgRNA, Crop improvement, Food Security,

AGRITECTURE – AN INNOVATIVE APPROACH TO THE MODERN AND SUSTAINABLE AGRICULTURE

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Agritecture is the art, science and practice of incorporating agriculture into the built environment. It is the fusion of agriculture and architecture. Agritecture consists of buildings that grow food. This integration process is emphasized to get maximum plant growth using the benefits of density indoors and microclimates outdoors. Agritecture is the unification of productivity and creativity in a very smart and scientific manner. This technique is mainly used in crops like (lettuce, broccoli, Tomato, Brinjal, Maize, Sorghum etc). The ultimate aim of agritecture is to improve the quality of agricultural products and persons who lives in the agricultural community. Agritecture is a smart agriculture technique in which more production with high quality products are obtained from a very small area. Agritecture includes vertical farming, rooftop farming, living walls and hydroponics. It reduces the water wastage, reduces the overuse of fertilizers, minimize the environmental pollution and produce pest free healthy products. Through the use of agritecture, people can now cultivate crops and grow food in urban areas. With this techniques people can grow off season crops by adjusting the micro-climate in the buildings and hatch extra income from this. Agritecture is an emerging technique in agriculture. Different remote sensing techniques that are used in the agritecture reduce the manual work load produces the quality products at proper time. This technique leads to the production of organic products as less chemicals and intensive monitoring is done. Agritecture complete the needs of increasing population in a very smart way. So, it also plays an important role in sustainable agriculture and modern farming.

Keywords: Agritecture, Vertical farming, Hydroponics, Microclimate, Remote Sensor

ANTIVIRAL HEALTH BENEFIT OF PLANTS: A REVIEW

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There are approximately 5000 types of virus. Some of the viruses are DNA virus and some others are RNA virus. Virus consists of the nucleic acid and the outer shell of protein. Virus can't live without host. When it enters in human or animal body, plants, insects or microorganisms it redirects their metabolism towards their own and make more and more copies of their genome and proteins. As a result affected living being suffers with virus related diseases. Rubeola virus cause measles and Varicella zoster virus(VZV) cause chicken pox, Human rota virus(HRV), Respiratory syncytial virus (RSV), Human rhino virus(HRV), various strains of poliovirus, Hepatitis A, B &C virus, Dengue virus, Herpes simplex virus(HSV), Human immune virus(HIV), influenza virus, H₁N₁ virus, Ebola virus, Zika virus, Corona virus etc cause various diseases. In vitro studies on various plants showed antiviral effects. Test tube studies on allium sativum showed antiviral activity against influenza A and B, HIV, HSV-1 viral pneumonia and rhinovirus. Studies on Ocimumbacilicum showed antiviral protection against herpes, hepatitis and enterovirus. Studies on Zingiber officinale showed protection against avian influenza and RSV. Sufficinolide of Salvia officinalis was found to combat HSV and HIV-1. Compounds of Glycyrrhiza glabra was studied for protection against SARS-CoV. Compounds of Origanum vulgare was studied and found for protection against HSV-1, HRV and RSV. Lemon was studied for antiviral against H₁N₁. Curcuma longa was studied for

antiviral activity against HSV, HIV and enterovirus. Natural products from medicinal plants have proved to be effective against a wide variety of viral diseases by inhibiting the replication cycle of various DNA and RNA viruses. This validated the use of plant based antivirals as an integral part of many traditional systems of medicine.

ENVIRONMENT POLLUTION AND DISASTERS: MONITORING AND MANAGEMENT

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Environmental issues are most underrated and over abused matter which is people facing World wide. As an agriculturist I feel shame sometimes about the condition we humans are putting forward for our environment. It's always wonderful to protect your environment before it shows the edge of falling down . Briefly explained, environmental pollution is one of the most serious global challenges. Wild-type organisms have a slower degradation rate of hazardous materials. Currently, advanced molecular biology tools along with conventional approaches allow us to rapidly degrade or accumulate hazardous materials from environments, where as an environmental disaster is an incident which takes place due to naturally or human actions, results in a harmful impact upon the natural environment. Agricultural Disasters, Industrial Disasters, Industrial Disasters, Human Health Disasters, Nuclear Disasters are the different types of disasters. Disasters due to toxic substances such as The Fukushima Nuclear Plant Disaster; and most recently the syerene gas leak in Vishakhapatnam (India) these causes challenging impact on environment. Different types, Causes, Factors, Consequences of Environmental Disasters are responsible and these are geological (earthquakes, landslides, tsunami, mining), Hydro-meteorological (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves,) Biological (epidemics, pest attacks, forest fire), Technological (chemical, industrial, radiological, nuclear) and Man-made (bomb blasts, building collapse, village and urban fire) hazards/disasters; Case Studies of recent disasters: Disasters at local, state and national level and preparation of disaster risk management plan; Significance of disaster management and the role of engineers in disaster management.If to monitor the environment disaster in the respect of agriculture , there will be three - four conditions due to which pollution accelerate ., and those are Droughts and dust clouds affect millions of people every year. In the 1930s, intense droughts in the southern Great Plains of the United States led to the infamous dust storms that gave the “Dust Bowl” region its name. The devastation that these dust storms caused to the agricultural sector is thought to have helped lengthen the Great Depression. When it comes to industries and household, When paints, solvents and other chemicals stored in households, or fuel stored in industrial tanks catch fire, they affect large areas and numbers of people. In 2015, slash-and-burn practices, principally on the Indonesian islands of Sumatra and Kalimantan, triggered forest fires which then spread quickly in the dry season. The toxic haze travelled around the region, triggering long-lasting air pollution crises in several Southeast Asian countries.Environmental Management and Disaster Reduction is an Introduction. The world is facing an increasing frequency and intensity of disasters - natural and man-made - that has had devastating impacts around the globe, land use and land cover changes are eroding the natural buffers that protect communities from hazard risk . The increasing frequency and severity of man-made and natural disasters may well be changing the global environment. All of these threats to the environment have been apparent in recent disasters. Current response to disasters need to be based on the premise that disasters affect the environment when they have direct or indirect effects on ecology and human settlements that last far beyond the scope of immediate humanitarian response. Changing ecological conditions can provoke emergencies by placing concurrent stresses on the

environment. Mitigating the effects of disasters are primary components in global efforts to ensure environmental security. There is a clear need to reinforce the importance of environmental concerns in the entire disaster management cycle of prevention, preparedness, assessment, mitigation and response and to integrate environmental concerns into planning for relief and rehabilitation.

PRODUCTION OF TRIPLOID RAINBOW TROUT BY PRESSURE SHOCK

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Rainbow trout is a low volume and high priced fish and a major candidate species for coldwater Aquaculture. Hence, expansion for its mass production has become a priority concern with maintaining the ecological biodiversity management in coldwater. Experiment was conducted at state trout farm, Uttarey, Sikkim. 100 healthy brooders were selected in ratio of 1:1 male and female to obtain the eggs. Time Temperature Unit-delay timing after fertilization to retain the second polar body (TTU) and exposure time of pressure shock treatment were standardized for better triploid induction rate (TR). Pressure shock at 9000, 9500 and 10000 psi for three level of time exposure 3, 5 and 7 minutes was applied to green eggs at 9.5⁰C water temperature. In all operations, pressure at 10000 psi and exposure time of 7 min resulted as all dead eggs. Viable eggs were obtained with pressure of 9000 and 9500 for exposure time of 3 & 5 mins. At pressure of 9000psi for exposure time of 5 min triploidy induction rate was recorded as 20-26%, while at 9500psi for 5 min induction rate was recorded highest as 98-100%. Study reveals that triploidy induction is feasible with pressure shock. Karyotyping of fry after yolk absorption and erythrocytes measurements was used for verification of triploidy. In treated group, three sets of chromosomes (88-90) were observed in chromosome plates. Erythrocytes measurement (μm) reflects the 13.2% larger cell size and 12.5% larger nucleus in triploids over the diploids. In triploids, the average size of the erythrocytes is 16.36 μm with 6.88 μm nucleus size, while it is 14.48 μm and 6.16 μm in case of diploids. Accuracy of TTU, exposure time of pressure shock and better rearing conditions are required for success of triploids production. The extra genetic material in triploid rainbow trout influence to be more heterozygous and exhibits enhanced growth and survival than its diploid counterpart. The technology would be helpful for promotion of aquaculture production of trout for livelihood support to the people dwelling in hills.

Keywords: Rainbow trout, triploidy induction, Pressure shock, Erythrocytes measurement.

DECIPHERING THE PREVALENCE AND INCIDENCE OF WILT DISEASE OF LENTIL CAUSED BY *Fusariumoxysporum*f.sp. *lentis* IN DIFFERENT LENTIL GROWING AREAS OF UTTARAKHAND

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Lentil is an important pulse crop having many nutritional values such as, it is one of the most nutritious pulse crops after chickpea, contains 24-26 percent protein, 57-60 percent carbohydrate, 3.2 and 1.3 percent fiber and it is also rich in the mineral nutrients like, Iron (7 mg per 100 g), phosphorus (300 mg per 100 g) and calcium (69 mg per 100 g). Lentil is affected by the several diseases which reduce its quality as well as the productivity of the crop. The lentil wilt is emerging as a big threat to the crop cultivation as it can cause upto 100 percent crop losses, reported from different lentil growing areas in India. The disease is caused by the fungal pathogen *Fusarium*

oxysporum.sp. *lentis*. It is a soil borne pathogen which survives in the soil and initiates the infection as soon as we sow the lentil seeds in the field, thereby leads to the huge crop losses. So by considering all these things it is essential to understand the status of this disease in the lentil growing areas of Uttarakhand, so that the farmers could be prepared with some preventive management strategies those should be designed as a part of cultural practices of the crop cultivation and can manage the disease economically. So the current study was done in 20 lentil growing areas of Uttarakhand and it was observed that the disease prevalence was 100 percent in all areas with incidence in the range of 6.45 to 23.25 percent. The 100 percent prevalence of the disease concluded the 100 percent presence of pathogen inoculums in the all the lentil growing soils, thereby alarming the emerging threat to the crop due to wilt disease. Although the disease incidence concluded that with the minimal plant protection strategies we can minimize the disease incidence and prevent the pathogen from being unmanageable after some course of time.

GENETIC VARIABILITY AND CORRELATION STUDIES FOR YIELD AND YIELD ATTRIBUTES IN TOMATO (*Solanum lycopersicum* L.)

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Forty tomato genotypes were evaluated in Randomized Block Design with three replications. The experiment was done in the experimental farm of college of horticulture, Department of vegetable science, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad, Telangana, *kharif*, 2017-18. The extent of genetic variability and association of yield and yield characters were determined in set of 40 Tomato genotypes. Analysis of variance revealed the existence of significant differences among genotypes for all the characters studied. High genetic variability was observed for the characters *viz.*, number of primary branches, number of fruits per plant, average fruit weight, fruit yield per plant and yield per hectare, which indicates the significance so, that these characters can be used for selecting superior genotypes. From correlation studies, fruit yield per plant exhibited high significant positive association with average fruit weight, fruit yield per hectare, lycopene and beta carotene indicating the importance of these traits in selection for yield. Direct selection based on these traits would result in simultaneous improvement of afore said traits and yield *per se* in tomato. The path coefficient analysis in the study revealed the improvement of yield by improving the characters *i.e* days to first flower, fruits per plant and average fruit weight. Yield per plant of tomato can also be increased indirectly through number of primary branches, days to fruit, number of fruits per plant and average weight of fruit.

Keywords: Correlation, Tomato, Heritability, Path co-efficient, Variability.

NANO EDIBLE COATINGS AND THEIR APPLICATIONS IN FOOD PRESERVATION

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India even being the 2nd largest producer of fruit and vegetable production in the world face 20 to 30% annual horticultural produce loss because of lack of adequate infrastructure and limited use of modern postharvest technologies. By the advance technology of nano-edible coatings a thin layer formed on the food surface to extend its shelf life represent one of the best ways to preserve the properties, functionality and characteristics of foods at a low cost. These coatings are easy to apply by spraying, immersion or rubbing, and are prepared with environmentally-friendly materials. Finally, they rarely need to be eliminated before consumption. By nano-technology, reducing particle size to nanometric scale gives materials distinct and improved properties compared to larger systems. For food applications, this technology allows the incorporation of hydrophilic and lipophilic substances with antimicrobial and antioxidant properties that can be released during storage periods to increase the shelf life of diverse products, including whole and fresh-cut fruits and vegetables, nuts, and among others. Edible coatings are usually prepared with natural polymers that are non-toxic, economical, and readily available. Nano systems, in contrast, may also be prepared with biodegradable synthetic polymers, and liquid and solid lipids at room temperature. Nano systems nowadays represent an important area of food research, and the best candidates for the development of more efficient edible coatings with high potential in applications in food preservation. Hence, there is a need of more research programs regarding application of the nano particles and their consumption prospective.

Keywords: Antimicrobial, Food, Nanoparticles, Postharvest, Spraying and Shelf life.

CHARACTERIZATION OF LITTLE MILLET USING ISSR MARKERS

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Little millet botanically called as *Panicum sumatrense* belongs to the family poaceae with chromosome number $2n=36$. It was domesticated in India and cultivated widely in hilly areas by the tribal people of Western Ghats. Little millets are known for its climate resilience, can withstand both drought and water logging condition. Due to its sparse cultivation and lack of knowledge about the genetic diversity, there is a need to restore it. Therefore genetic diversity among 18 little millet genotypes was evaluated based on 16 ISSR markers. A total of 370 alleles were detected out of which 162 were unique alleles. All the primers were highly polymorphic and the size of amplified product was in the range 354-2315 bp. The primer UBC 807 showed higher level of polymorphism percent (78.12%) and Polymorphism Information Content (0.989). On average, 27.18 alleles per primer and 10.12 unique alleles were detected. The dendrogram was constructed based on Dice's similarities coefficient was obtained by Unweighted Paired Group Method using Arithmetic mean (UPGMA). The 18 genotypes of little millet were grouped into five clusters; each cluster consisted of four genotypes except cluster 4 having two genotypes. The present study revealed the presence of diversified genotypes among the population which could be utilized as superior parents during crop improvement programme.

Keywords: Little millet, Inter Simple Sequence Repeats (ISSR) and Genetic diversity

MORINGA YIELD IMPROVEMENT WITH THE AID OF INDIAN HONEY BEES

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Moringa is an important vegetable crop that mostly depends on insect pollinators for its fertilization. The fertilized crop was producing increased yield and more seeds. A study was conducted to know the efficient pollinator in moringa ecosystem. The Indian bee hives were transported and kept into the moringa orchard at various distances viz., 10m, 100m, 200m and 500m. The number of insects visiting drumstick inflorescence were counted by visual observation for 12 hours. The mean population of *Apis cerana indica* was the highest (3.85/ 25 inflorescence/5 min) followed by *Amegilla zonata* (3.15), *Xylocopa* sp. (2.4), *A. dorsata* (1.60), *Polistes* sp. (1.20), *Danaus chrysippus* (0.20), *Papilio polytes* (0.10) and *Pieris rapae* (0.05) which were highly significantly different. Also, the yield and yield parameters including number of fruits per tree, fruit size, individual and total fruit weight were worked out from the hive. Results included number of fruits per tree which was ranged from 202 to 189.4 fruits at 10 m to 500 m. The fruit length (55.6 to 53.2 cm), fruit girth (7.9 to 7.81 cm), individual fruit weight (99.3 to 94.2 g) and fruit yield (41.3 to 36.33) were varied from at 10 m to 500 m. All these yield parameters were significantly different from one another at various distances from the hive except fruit girth. By augmenting Indian honey bee colonies in moringa orchard, we can increase the quality and quantity of moringa fruits.

Keywords: Moringa, Pollination, Honey bee, Yield.

TO STUDY THE CONSTRAINTS FACED BY SCIENTISTS AND SEEK SUGGESTIONS BY SCIENTISTS WORKING IN KVKs OF GUJARAT

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Krishi Vigyan Kendras (KVKs) are remote level organizations meant for application of technology through assessment, refinement, and demonstration of proven technologies under different 'micro-farming' situations in a district. The KVKs are devoted to the vocational training of the practicing farmers, farm women, rural youth, school dropouts, and field level extension functionaries. On field level scientists face lot of practical problems while working in KVKs situated at the remote areas affecting their role performance to appropriate technology dissemination. Considering their difficulties, the present study was carried out to study the constraints faced by them and also to elicit the suggestions by the scientists working in KVKs of Gujarat. The study was carried out with the 97 scientists as a respondent during 2018-19. Major constraints faced by them were non-availability of funds, lack of transport facilities, lack of infrastructure, lack of farm machinery, lack of encouragement from superiors in taking part in various activities. Suggestions elicited were the timely allocation of the fund and the need to increase the fund allocated to all KVKs should be improved, the infrastructure of KVKs should be improved, the strength of KVK staff should be increased by adding new discipline.

Keywords: Constraints, suggestions, role performance, KVKs scientists.

EFFICACY OF HERBAL FEED ADDITIVES IN GONADAL MATURITY AND CAPTIVE BREEDING OF SNOW TROUT (*schizothoraxrichardsonii*)

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Study was conducted to investigate the influence of dietary supplementation of Ashwagandha (*Withaniasomnifera*) root powder, leaf extract of *Aloevera*, seed powder of *Mucuna pruriens* and dried powder of garlic (*Allium sativum*) in gonadal maturity and milt production in male brood stock and leaf extract of *Aloevera* powder, powder of *Myristica fragrans*, flower powder of *Butiamonosperma* and dried powder of garlic (*Allium sativum*) in gonadal maturity and spawning of female brood stock of commercially important indigenous coldwater fish, snow trout, *Schizothoraxrichardsonii* in captive condition. Brood stock was reared in FRP tanks (n=6) of 1200 L capacity. Each tank was stocked with 3 years old fish (n=20) and fed with one control (D1) and two experimental diets (D2, Diet for males and D3, diet for females) in duplicate at the feeding rate of 3-5% of their body weight twice in a day. Gonadosomatic index (GSI) and Hepatosomatic index (HSI) were recorded for pre and post breeding period (60 days) coupled with regular monitoring of water quality parameters. In treated groups, the GSI values ranges from 5.33% to 14.10%, in females and 1.52% to 6.74% in male fishes. In treated groups, 82% specimen were observed mature for breeding operation, while only 18% specimen were found mature in control group. The relative fecundity of the fish was observed in the range of 1700-1800 eggs/kg body weight with 80-94.2% fertilization. The egg size was observed in the range of 3.5-3.8 mm. The study revealed that dietary inclusion of herbs additive has positive impact on gonadal maturity and captive breeding of snow trout. 1.0 % supplementation in fish diet with blend of herbs for male and female stock separately would be beneficial in captive maturation and breeding of snow trout.

Keywords: gonadal maturity, spawning, milt, Gonadosomatic index, fecundity, blend of herbs.

CLIMATE SMART AGRICULTURE AND SUSTAINABLE INTENSIFICATION: AN APPROACH TOWARDS MITIGATING FOOD INSECURITY

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Climate change disrupts food markets, posing population-wide risks to the food supply. Climate smart agriculture (CSA) proposes an alternative 'climate-wise' framework to foreground the inherently political dimensions of food and agriculture in an era of climatic change. With its emphasis on improving risk management, information flows and local institutions to support adaptive capacity, CSA provides the foundations for incentivizing and enabling intensification. Researches in East Africa have revealed that Banana-coffee intercropping in elevated temperature regions; multiple cropping, crop rotation, agroforestry, carbon sequestration, agriculture allied sectors, etc., can contribute to mitigation and storing an additional carbon per ha in the soil. The sustainable intensification (SI) of livestock production systems could contribute enormously to both adaptation and mitigation. The use of stone bunds can lead to nutritional benefits, while also allowing farmers to cope with changing weather (adaptation to wetter or drier

climates). Soil fertility is often improved as a result of more manure being applied, and increased tree cover contributes further mitigation benefits. Thus, these techniques are climate smart form of sustainable intensification. There are increasing possibilities for low-income countries to orientate production along pathways that are both more sustainable and more productive to mitigate food insecurity. The assessment of technology preferences is based on farmers' current level of understanding about the benefits and costs of individual CSA technology. Farmers prefer some risk mitigation technologies such as crop insurance, agro-advisories and rainwater harvesting that can be supported by the government. Therefore, farmers' preferences for CSA technologies may differ based on their expectations of financial support from the government and other agencies. Similarly, their preferences may differ based on the combination of CSA technologies and their potential benefits for adaptation to climate change. There is a need for these issues to be further explored.

Keywords: climate smart agriculture, food security, sustainable intensification, climate change

**LEH-LADAKH: A NEW POTENTIAL HABITAT FOR ARUNA (*Aconitum heterophyllum*)
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Aconitum heterophyllum is a perennial herb native to the Western Himalayas and has been found distributed in Kashmir, Uttarakhand, Sikkim and Nepal. Roots of this plant have been found to show antidiarrheal, hepatoprotective, antipyretic antioxidant and carminative properties. Aconitine and atisine (alkaloids) are the marker compounds of *A. heterophyllum* which are used in commercial preparations. But increased consumption of this plant for medicinal preparation has led it towards extinction. Therefore, it has become essential to carry out extensive studies on trend of population, reproductive biology and alternative propagation techniques to support its conservation programmes. Plant tissue culture of this plant can act as effective approach for large scale cultivation without destroying the natural resources for extraction of phytochemicals. Leh-Ladakh is the northern most of country with the adverse environmental conditions which are responsible for accumulation of secondary metabolites.

Keyword: *Aconitum heterophyllum*, Micropropagation, Leh-Ladakh

**WATER QUALITY ASSESSMENT OF HINDON RIVER USING WATER QUALITY
INDEX AND RIVER METAL POLLUTION INDEX**

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According to World Economic Forum water is a pressing societal and geopolitical issue they also lists water crises as the largest global risk in terms of potential impact. Heavy metals in water are one of the major concerns for researchers nowadays. Heavy metals are difficult to degrade and accumulate in the food chain which led to severe impacts on the quality of fresh water aquatic system and economic activities. Water quality index (WQI) was calculated for assessing the Hindon river water quality in different seasons i.e. premonsoon and postmonsoon. Water samples were

tested and digested for heavy metals (Fe, Zn, Cd and Pb). Water quality index is applied to various physicochemical parameters whereas River metal pollution index is applied to different metal concentration in Hindon River. It represents the total quality of water with respect to metals. The total concentration in water was recorded in the order of $Zn > Fe > Pb > Cd$. Results of both the parameters indicate severely polluted water quality of Hindon river. The results of the present findings will be presented in the conference.

Keywords: Hindon River, Water pollution, Heavy Metal, Pollution Index.

PRODUCTION OF BABY CORN INFLUENCED BY NITROGEN APPLICATION AND CROP GEOMETRY **NITIN KUMAR**

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Baby corn is a short duration crop, comprised of unfertilized maize ear which is harvested within 2-3 days of silk emergence. It is a newly introduced crop in India and being a high-value and short span crop (50-60 days) it has a good prospective in improving the financial status of the farmers. Advancement and standardization of agronomic practices are required before familiarizing the crop among farmers. Among different agro-techniques, crop geometry and Nitrogen application are considered as one of the most important factors to production yield of crop. Nitrogen deficiency is a broad phenomenon its proper management is mandatory from financial and environmental view. It is concluded in studies that the yield of crop increase with an increase in N rates but the optimum dose is dependent upon plant density. However response of N application was different for quality and yield attributes. Plant density is another major aspect of the performance of baby corn. It is reported that quality attributes were much better in wider spacing due to a decrease in plant density. It is also reported that narrow spacing and increase in N application concurrently increase the yield attributes. More research studies are needed on combined approach (Plant geometry and N application) in the baby corn can intensify yield and quality in baby corn. Optimization of both attributes is depended on location and season. However, economically effective and user's friendly precision tools may be a feasible option for getting the real farm situation.

Keywords: Baby corn, Nitrogen management, planting geometry

ACTIVENESS *DACTYLOCTENIUM AEGYPTIUM* EXTRACTS ON SOIL BORNE FUNGAL PHYTOPATHOGENS AND GERMINATION EFFECTS OF ON DIFFERENT PART OF GREEN GRAM

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As it is well known that intensive and indiscriminate use of chemicals in agriculture has caused very serious problems to the environment and as well as the human beings as it has poisoned our food also contaminated for soil and water. Aim to make light of the adverse effect of these chemical pesticides the extract of *Dactyloctenium aegyptium* was used against the soil borne plant pathogens *i.e.* *Fusarium oxysporium*, *Rhizoctonia solani*, *Sclerotinia sclerotiorum* and *Sclerotium rolfsii*. The effect of extracts was also observed on the different parameter of moong crop. To test the allelopathic effect by the phytochemical, extracted from the weed *Dactyloctenium aegyptium*. In

which the heptane extract of the weed was found to be most effective against the fungal plant pathogens followed by methanol and benzene *i.e.* 0.00, 3.25 and 4.65 over the control which was 6.3 in *Fusarium oxysporium*. In case of green gram germination, *Dactyloctenium aegyptium* in different solvent at 25% concentration, butyl alcohol was the highest in increasing the germination percentage [100] show effectiveness. The leaves, root and stem length show highest effectiveness respectively methanol heptanes and water. The overall effectiveness of the different extract against the fungal plant pathogens were found significantly effective. As the weeds are found in majority in the vicinity of the main crop and our surrounding these weeds can be a good alternative of chemically based fungicides to control these kinds of fungal plant pathogens.

Keywords: *Dactyloctenium aegyptium*, Fungal Phytopathogens & Moong crop.

ACTIVE AND INTELLIGENT PACKAGING FUNCTIONS IN POST-HARVEST LOSS REDUCTION: A STUDY

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India, having diverse agro-climatic conditions and varied soil type offer extreme scope for cultivation of various types of horticultural crops. India is the second-largest producer of both fruits and vegetables in the world after China. Horticultural crops having a shorter shelf life, are more prone towards post-harvest losses hence, about 20-44% of horticulture produce, gets wasted for SAARC countries during post-harvest handling, which results in huge loss of a great amount of money at both farmer and trader's level. Active and intelligent packaging is a new and exciting area of technology which received efficient contemporary consumer response. The present study aims to present active and intelligent packaging prevalent in the market and their influence in extending the shelf life of horticultural produces along with future developments that can be done in the field of the innovative packaging industry. Active packaging systems are categorized as active compounds that are stuffed into sachets or pads and then added in the package and active compounds are added directly into the package or on the packaging material. Intelligent packaging includes indicators giving information about the quality and safety of the product; history of a package, atmosphere inside and outside the package, etc. It gives information to the producer, retailer, and consumer about quality and the surrounding environment. Implementation of these innovative technologies is not yet achieved despite extensive research. Intensive communication of their usefulness in food product applications will facilitate the successful development and market introduction and will help in reducing post-harvest losses. There is a huge increase in the production of these innovative packaging systems and their commercial and successful market implementation might act as a boon for the packaging industry.

Keywords: Active Packaging, Consumer, Intelligent Packaging, Post-harvest losses, and Shelf-life.

EFFICACY OF POST – EMERGENCE HERBICIDE (IMAZETHAPYR) ON WEED MANAGEMENT IN LENTIL (*Lens culinaris* L.)

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A field experiment (on farm trail) was conducted during the winter season of 2015-16 and 2016-17 at Kakan village of Jamui district (Bihar) in farmers participatory mode to study the efficacy of post emergence herbicide (Imazethapyr) on weed management. The experiment was laid out in randomized block design comprising of five treatments replicated thrice. The treatment were as T₁ - Imazethapyr at 20 g ha⁻¹, T₂ - Imazethapyr at 25 g ha⁻¹, T₃ - Imazethapyr at 30 g ha⁻¹, T₄ One hand weeding at 20 DAS and T₅ – Weedy check (control). The field was dominated with grassy weeds like. Treatment T₂ significantly reduce the weed population (4.5 m²) and their dry weight (5.1 g m²) and provide maximum growth characters viz. plant height (40.8 cm), no. of branches plant⁻¹ (5.10), no. of pods plant⁻¹ (32), no. of seeds pod⁻¹ (1.79) and test weight (24.00 g) as compared to all other treatments. The results also revealed that treatment T₂ was the best treatment regard to weed control efficiency (80.25%) and higher grain yield (1.04 t ha⁻¹) followed by other treatments. Application of Imazethapyr at 25 g ha⁻¹ has recorded significantly higher net returns (Rs. 23,400 ha⁻¹) and B:C ratio (1.75). Thus application of Imizaethypr at 25 g ha⁻¹ at 25 days may be recommended for managing weeds and obtaining higher grain yield of lentil.

Keywords: Imazethapyr, Lentil, Weed control efficiency, Weed population, Growth characters.

EVALUATION OF PROMISING GENOTYPES OF FRENCH BEAN FOR WESTERN PLATEAU REGION OF JHARKHAND

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French bean (*Phaseolus vulgaris* L.) belongs to the family Fabaceae having a chromosome number $2n = 2x = 22$. It is consumed as fresh vegetables or dry seeds (known as dry bean or Rajmah). In India, French beans are grown during the season of *kharif* and *rabi* both. During *kharif* season mostly pole type are grown whereas during *rabi* season generally bush types are popular. In recent years, public sector and private seed companies in India have been able to develop a good number of commercial cultivars but they are not suitable to all the regions of the country. They are varying in various characters from one region to another. Now a day's large numbers of French bean genotypes are available in the market but all these are not adapted and suited to all the regions. No specific recommendations about the suitability of genotypes for a particular area are available. Farmers are facing problems in selecting genotypes for a particular area for commercial cultivation. Considering the above mentioned facts, there is a need to compare some of the available genotypes to select high yielding better adaptable genotypes for commercial cultivation. Therefore, the present investigation was carried out to identify superior and promising genotype with respect to yield, disease resistance and quality of the produce under plateau condition in Jharkhand. An experiment was carried out during *rabi* 2017-18 and 2018-19 at Zonal Research Station, Chianki using seven promising genotypes with three replications in randomized block design. Observations on nine important characters were recorded. Analysed data revealed that out of seven entries of French

beans, the genotype HAFB-2 gave significantly highest yield with the value of 93.63 q/ha during 2017-18 and 88.90 q/ha during 2018-19 followed by NS-636 (79.99 q/ha during 2017-18 and 75.82 q/ha during 2018-19) and HAPB-4 (72.53 q/ha during 2017-18 and 71.80 q/ha during 2018-19). With respect to earliness, HAFB-4 was found the best genotype in desired direction. On the basis of these observations, it may be concluded that the genotype HAFB-2 was found the most suitable genotype for *rabi* cultivation in the western plateau region (sub zone-V) of Jharkhand as well as similar agro-climatic condition of the neighboring states.

Keywords: French bean, Fabaceae, Genotype, Evaluation

EFFECT OF DIFFERENT METHODS OF IRRIGATION ON YIELD OF POTATO

**ASHOK KUMAR, MUKESH KUMAR, VINOD KUMAR AND RITA LAL
KVK, Munger**

An OFT was conducted on six farmers field to observe the effect of different methods of irrigation on yield of potato. The fields of farmers were fertile, plain and having clay loam soil. The trails were furrow irrigation, furrow irrigation with 25 % cut off time, alternate furrow irrigation and alternate furrow irrigation with 25% cutoff time conducted on the farms of Hasanpur's farmers. There were four treatments which were replicated on six farmers' field. The treatment 3rd (alternate furrow irrigation at 25 % cut off time) was found the best treatment in terms of maximum yield 210 q/ha. Water efficiency 9.13 q/ha-cm, net return Rs 62100/ha and BC ratio 3.50 Followed by TO2, TO1 & FP consecutively. The yield quality was found better and saving of water(13.4c.m.)(35.20 % in comparison to farmer's practice)

Keywords: yield, water efficiency, water requirement, net return (profitability), clay loam, alternate furrow irrigation , cut off time.

EFFECT OF DIFFERENT METHODS OF IRRIGATION ON YIELD OF CAULIFLOWER

**ASHOK KUMAR, MUKESH KUMAR, VINOD KUMAR AND RITA LAL
KVK, Munger**

An OFT was conducted on nine farmers field with three treatments to evaluate water use efficiency, net income and BC ratio. The treatments were farmer's practice: wild flood irrigation, check basin irrigation & furrow irrigation. The treatments were replicated on nine farmers fields of chandanpura village. The irrigation method was found the best irrigation methods in terms of maximum yield (205 q/ha), water use efficiency (971.56 kg/ha-cm) average curd weight (418 gm), net income (Rs 92100/ha) & BC ratio (3.98) followed by TO1 & FP respectively. Total water requirement was found 28.5 cm in traditional irrigation and 21.1 c.m. in furrow irrigation methods. Thus 7.4 c.m of irrigation was saved in furrow irrigation in comparison to traditional irrigation.

Keywords: Yield, water efficiency, water requirement, net income (profitability), furrow irrigation, BC ratio.

EFFECT OF PLANT GROWTH REGULATOR AND MICRONUTRIENT ON YIELD AND FRUIT QUALITY OF ACID LIME (*Citrus aurantifolia* Swingle.) cv. Kagzi

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To study the effect of plant growth regulator and micronutrients on yield and fruit quality of acid lime (*Citrus aurantifolia* Swingle.) cv. Kagzi. An experiment was conducted in the citrus orchard at village Sohara Khurd, District Pathankot, Punjab during the year 2018-19. The experiment was laid out in a randomized block design (RBD) having nine treatments with three replications. Treatments consisted of GA₃ (50ppm and 100ppm), NAA (100ppm and 200ppm), ZnSO₄ (0.4% and 0.5%) and Boron (0.4% and 0.5%), while in control water is sprayed. However, the plants treated with GA₃ showed highest fruit weight (45.36 g), fruit length (4.39 cm), fruit breadth (3.46 cm), yield per plant (37.92 kg), yield per hectare (18.96 tonnes), TSS (9.51⁰B), ascorbic acid (48.11 mg/100g pulp), total sugar (1.87%), reducing sugar (0.63%), acidity (8.33 %) and non-reducing sugar (1.24%) . Studies indicated that plant growth regulator and micronutrients are quite useful for improving yield and fruit quality of acid lime and getting higher marketable value in subtropical region.

Keywords: Acid lime, GA₃, Boron, Quality, Yield, Zinc, NAA

PREPARATION OF POMEGRANATE JELLY BY USING DIFFERENT SWEETENING AGENTS cv. Kandhari

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Pomegranate (*Punicagranatum* L.) family "Punicaceae" is a highly valued crop and is widely cultivated in Mediterranean countries. Pomegranate is a favorite table fruit of tropical and subtropical countries. The arils of fruit form the edible part which contains cool refreshing juice. The present investigation entitled, "Preparation of Pomegranate Jelly by using different sweetening agents" cv. Kandhari" was carried out during 2017-18 in the Fruit Science Laboratory of Department of Agriculture, Mata Gujri College, Fatehgarh Sahib, Punjab. The experiments were laid out in completely randomized design (CRD) with six treatments viz- T₁ (Control), T₂ (Sugar + Pectin + Citric acid), T₃ (Jaggery + Pectin + Citric acid), T₄ (Honey + Pectin + Citric acid), T₅ ([Sugar + Jaggery] + Pectin + Citric acid) and T₆ ([Sugar + Honey] + Pectin + Citric acid) . Each treatment was replicated 5 times having 500g fruits under each replication. The results of the research show that in maximum rating of TSS% and pH value was evaluated in T₂. There is also impact of treatment on TSS% and pH value in Treatment T₄(Honey + Pectin + Citric acid) showing minimum rating of TSS% and pH value as compared to other treatments. The results of the research shows that Pomegranate Jelly from T₂(Sugar + Pectin + Citric acid) showing maximum rating of taste, colour and overall acceptability. Mostly treatment combinations show significant interactions.

Keywords: Pomegranate, Sugar, Jaggery, Honey, Pectin, Citric acid, TSS%, pH value, organoleptic acceptance

INFLUENCE OF DIFFERENT DOSE OF INORGANIC FERTILIZERS AND BIO-ENHANCERS ON QUALITY OF RED CABBAGE (*Brassica oleracea* var. *capitata* f. *rubra*.)

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The present investigation entitled was “Influence of different dose inorganic fertilizers and Bio-enhancers on quality of red cabbage (*Brassica oleracea* var. *capitata* f. *rubra* L.)” conducted during Rabi 2018-19 at the experimental farm Department of Agriculture, Mata Gujri College, Sri Fatehgarh Sahib, Punjab, India. The experiment was laid out in a randomized block design with three replications and eleven treatments. The treatments consisted of T₁: Control, T₂: 80% RDF (water spray), T₃: 100% RDF (water spray), T₄: 80% RDF + Panchagavya (5%), T₅: 80% RDF + Sanjeevak (10%), T₆: 80% RDF + Jeevamrutha (7%), T₇: 80% RDF + Dashagavya (10%), T₈: 100% RDF + Panchagavya (5%), T₉: 100% RDF + Sanjeevak (10%), T₁₀: 100% RDF + Jeevamrutha (7%), T₁₁: 100% RDF + Dashagavya (10%). Bio-enhancers applied via foliar spray at the interval of 15, 45 and 75 days after transplanting. Application of different level of inorganic fertilizers and Bio-enhancers increase the quality of red cabbage. The total soluble solids (8.43 Brix), titratable acidity (0.20%), head dry matter (7.63%), moisture content (92.37), ascorbic acid (57.24 mg 100g⁻¹), Vitamin A (278.18 mg 100g⁻¹), anthocyanin (36.39 mg 100g⁻¹), physiological loss in weight (9.45 %) and shelf life (18.60 days) were recorded with the application of T₁₁ (100% RDF + Dashagavya 10%). Therefore, application of (100% RDF + Dashagavya 10%) may be suggested after on-farm testing in trail for commercial cultivation of red cabbage for getting higher yield with maximum net returns unit⁻¹ area in red cabbage.

Keywords: Bio-enhancers, Inorganic, Fertilizers, Dasagavya

EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON GROWTH, YIELD AND FRUIT QUALITY OF GUAVA (*Psidium guajava*) CV. ALLAHABAD SAFEDA

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The present investigations on “Effect of foliar application of micronutrients on growth, yield and fruit quality of Guava (*Psidium guajava*) cv. Allahabad safeda” was conducted at in the farm, Village-Sarawan Bodla, Tehsil- Malout, Distt- Sri Muktsar Sahib, Punjab during 2018-2019. Experiments were laid out in randomized block design (RBD) with thirteen treatments viz. T₁- Zn₁ @ 0.5 %, T₂-Zn₂ @ 1.0 %, T₃-Cu₁ @ 0.5 %, T₄- Cu₂ @ 1.0 %, T₅- B₁ @ 0.5 %, T₆-B₂ @ 1.0 %, T₇- Fe₁ @ 0.5%, T₈- Fe₂ @ 1.0 %, T₉ Mg₁ @ 0.5 %, T₁₀ Mg₂ @ 1.0 %, T₁₁ Mn₁ @ 0.5 %, T₁₂ Mn₂ @ 1.0 % and T₁₃ Control. The maximum growth parameters viz., plant height (cm), stem girth (cm) canopy volume E-W (m), canopy volume N-S (m) were reported with the application of T₂ i.e. Zn₂ @ 1.0 % which was at par with application of T₁-Zn₁ @ 1.0 % and T₄ – Cu₂ @ 1.0 % and it was significantly superior over the other treatments at all stages of observation. The maximum yield kg plant⁻¹ and total no. of fruits plant⁻¹ was recorded in T₂ i.e. Zn₂ @ 1.0 % which was at par with application of T₁-Zn₁ @ 1.0 % and T₄ – Cu₂ @ 1.0 % and it was significantly superior over all treatments. The maximum fruit weight was reported in T₂ i.e. Zn₂ @ 1.0 % which was at par with application of T₁-Zn₁ @ 1.0 % and T₄ – Cu₂ @ 1.0 %. The maximum chemical parameters viz., TSS (°Brix), ascorbic acid (mg/100g) and all sugars (%) were reported with the application of T₂ i.e. Zn₂

@ 1.0 % which was at par with application of T_1-Zn_1 @ 1.0 % and $T_4 - Cu_2$ @ 1.0 % and it was significantly superior over the other treatments at all stages of observation.

Keywords: Guava, Micronutrients.

COMBINING ABILITY ANALYSIS FOR YIELD AND ITS YIELD TRAITS USING HALF DIALLEL MATING DESIGN IN INDIAN MUSTARD (*Brassica juncea* L.)

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The present investigation on Indian mustard was comprised of a half diallel set of 5 parents and their 10 crosses. Two cross combinations exhibited positive significant heterobeltiosis for seed yield/plant. On the basis of per se performance and estimates of heterosis, the cross Narinder Rye × IC 597879 found to be most promising followed by IC 599679 × IC 597879 for seed yield/plant. GCA effects revealed that the Jawahar Mustard having significant and positive GCA effects was found to be the best combiner for most of the yield contributing traits and on the basis of SCA, IC 597878 × IC 598692 and Jawahar Mustard was recorded best specific combination for most of the yield contributing traits. It may be concluded that Jawahar Mustard is a good general combiner and Jawahar Mustard × Narinder Rye and IC 597879 × IC 598692 is a best specific combination for higher yield. The association studies among different characters revealed that seed yield/plant had significant positive correlation with biological yield/plant. High heritability estimates in broad sense along with high genetic advance as percent of mean was observed for seed yield/plant, test weight and harvest index. The high PCV and GCV were observed for biological yield/plant (g) whereas, moderate GCV and PCV was recorded test weight, number of secondary branches/plant, number of siliquae/plant and siliqua length indicating prevalence of genetic variability for these traits, which can successfully be utilized for genetic improvement of seed yield in Indian mustard.

Keywords: Heterosis, Combining ability, Correlation and Path coefficient, Genetic advance and Heritability.

EFFECT OF VERMICOMPOST AND BIOFERTILIZERS ON CHEMICAL PARAMETER AND YIELD OF STRAWBERRY (*Fragaria × ananassa* Duch.) cv. CHANDLER IN CENTRAL PLAIN REGION OF PUNJAB

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The experiment was conducted at the research farm, Department of Agriculture, Mata Gujri College, Sri Fatehgarh Sahib, Punjab during 2017-18 to study the effect of vermicompost and biofertilizers on chemical parameter and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Chandler in central plain region of Punjab. The Experiment was laid out in Randomized Block Design with 9 treatments replicated thrice. Treatments consisted of vermicompost and biofertilizers (Arka Microbial Consortium, phosphate solubilizing bacteria and *Azospirillum*). Each treatment alone and their combination has shown significant effects on most of the parameters, but the combination of vermicompost, Arka Microbial Consortium, PSB and *Azospirillum* showed maximum number of fruits plant⁻¹, yield plant⁻¹ and yield ha⁻¹. However, minimum number of days taken to produce first flowering was recorded in the plants which were treated with T_9 (AMC @ 7 kg/ ha + VC @ 5 tones/ ha + PSB @ 7 kg/ha + *Azospirillum* @ 7 Kg/ha). The maximum total soluble solid (12.83 OBrix), ascorbic acid (60.30 mg/100 g pulp), total sugar (7.61 %), reducing

sugar (4.24 %), non-reducing sugar (3.37 %), anthocyanin content (0.220 OD at 530 nm) was recorded in treatment T9 (AMC @ 7 kg/ ha + VC @ 5 tones/ ha + PSB @ 7 kg/ha + *Azospirillum* @ 7 Kg/ha). Hence, on the basis of overall findings of present investigation, T₉ (AMC @ 7 kg/ ha + VC @ 5 tones/ ha + PSB @ 7 kg/ha + *Azospirillum* @ 7 Kg/ha) significantly exhibited the maximum effect on higher yield and chemical parameter.

Keywords: Strawberry, Vermicompost (VC), AMC (Arka Microbial Consortium), *Azospirillum*, PSB, Biofertilizer and Yield.

SOIL TEST BASED FERTILIZER PRESCRIPTIONS UNDER INTEGRATED NUTRIENT MANAGEMENT FOR TARGETED YIELD OF FRENCH BEAN AND MAIZE IN MOLLISOL OF UTTARAKHAND

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Field experiment was conducted at Norman E. Borlough Crop Research Centre of G.B. P. U. & T. Pantnagar to formulate the fertilizer prescription equations for French bean and Maize under integrated nutrient management system on Mollisol during 2013-14 following targeted yield approach. The experiment was conducted in two phase. In first phase soil fertility gradient was created and in second phase test crops french bean and maize were grown in sequence. Crop response to selected combinations of four levels of nitrogen (0, 60, 120 and 180 kg ha⁻¹ for french bean and 0, 40, 80 and 120 kg ha⁻¹ for maize), four levels of phosphorus (0, 35, 70 and 105 kg P₂O₅ ha⁻¹ for french bean and 0, 30, 60 and 90 kg P₂O₅ ha⁻¹ for maize), four levels of potassium (0, 25, 50 and 75 kg K₂O ha⁻¹ for french bean and 0, 20, 40 and 60 kg K₂O ha⁻¹ for maize) and three levels of FYM (0, 5 and 10 t ha⁻¹ for both the crops) at different fertility levels was studied. The nutrient requirement to produce one quintal grain yield was 6.91 kg nitrogen, 0.73 kg phosphorus and 8.48 kg potassium for french bean while for maize the values were 2.26 kg nitrogen, 0.74 kg phosphorus and 2.02 kg potassium, respectively. Contribution of nitrogen, phosphorus and potassium from soil was 15.16, 19.28 and 23.95 % in french bean and 26.31, 75.86 and 23.51 % in maize, whereas from FYM it was 32.52, 3.50, 53.42 %; in french bean, 20.76, 19.37, 27.80 % in maize, and from chemical fertilizer 29.10, 11.29, 85.04 in french bean and 21.97, 28.58, 74.54 % in maize. Percent contribution of nutrient from combined use of chemical fertilizer and FYM was 35.05 for nitrogen, 12.50 for phosphorus, 112.79 for potassium in french bean and 31.37 for nitrogen, 39.23 for phosphorus and 96.10 for potassium in maize. Based on this information fertilizer prescription equations were developed to predict fertilizer recommendation for obtaining specific yield targets of french bean and maize. Findings of present study may be used as guide for fertilizer recommendation in similar type of soils.

Keywords: French bean, Maize, Target yield, fertilizer adjustment equation, Mollisol

RICE STRAW COMPOST- AN ALTERNATIVE TO STUBBLE BURNING

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Crop residue burning is one of the major environmental problems causing global warming. Rice residue burning results in loss of soil nutrients, soil organic matter, soil productivity, air quality and biodiversity. In India about 500 million tonnes of crop residues are produced every year. The major crops which contribute to residue burning are rice, wheat and sugarcane. According to IPCC, about 25% of crop residues are burnt on the field. The percentage of rice residues burned ranges from 8-

80% across the country. The residue burning can be checked to some extent by converting these organic waste into fertilizer by a process called composting. Composting is the natural process of decomposition of organic matter under controlled conditions. It is mediated by different microorganisms like bacteria, fungi, actinomycetes, algae and protozoa. The rice straw contains good amount of nutrients and 1 tonne of rice straw contains 0.5 to 0.8 % N, 0.16-0.2 % P₂O₅, 1.4-2.0 % K₂O, 0.005-0.10 % S and 4-7 % Si. The conventional composting methods takes longer time during the processing period so this can be avoided by addition of inoculum such as biogas slurry, cattle dung, fungal consortium. The composting of rice straw helps in availability of nutrients present in straw and also prevents the residue burning which reduces environmental problems and also prevent the loss of nutrients in soil.

Keywords: Crop residue burning, Global warming, Composting

RESPONSE OF WHEAT (*Triticum aestivum*) TO SEEDING METHODS AND WEED MANAGEMENT PRACTICES

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The experiment was conducted at Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P., during rabi season 2019-2010. The experiment consisted of three methods of sowing FIRB system, Broadcast and Line sowing method and five weed management practices namely weedy check, weed free, sulfosulfuron at 33 g/ha, Metsulfuron at 4 g/ha and Isoproturon at 750 g/ha (postemergence). Highest plant height, plant dry weight, Crop Growth Rate and Relative Growth Rate was found in the treatment FIRB system of sowing while the weed management practices sulfosulfuron at 33 g/ha recorded maximum plant height, maximum plant dry weight, Crop Growth Rate and Relative Growth Rate. Minimum weed density, weed dry weight and weed index was recorded in FIRB system of sowing. Among the weed management practices sulfuron at 33 g/ha recorded minimum weed density, weed dry weight and weed index. More number of spike/plant, grains/spike, highest test weight, grain yield, and straw yield was recorded in FIRB system of sowing while in weed management practices these parameters were highest in sulfosulfuron at 33 g/ha.

Keywords: wheat, FIRB, sulfosulfuron, Metsulfuron, Isoproturon.

STRATEGIES FOR DOUBLING FARMER'S INCOME IN HILLY TERRAINS BY ADAPTING HORTICULTURE BASED INTEGRATED FARMING AGRICULTURE ENTREPRENEURSHIP MODEL

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Uttarakhand being a predominantly hilly state has most of its area under forests and wastelands leaving only about 14% out of the total area. Out of the total farmers, 89% come under the small and marginal category, because of this people in hilly regions of Uttarakhand are not able to follow large scale commercialized farming. The objective of the present study is to provide a Horti based Agri-entrepreneurship model for the villages of Garhwal region for doubling farmer's income in these regions through agricultural development. The present model was formulated based on the

past studies conducted at 3 villages of Garhwal region *i.e.*, Village Sainji and Dhulet under PaboBlock District Pauri Garhwal and Village Bhaiswara under Kirtinagar Block District Tehri around 10 Km from Srinagar Garhwal. Almost every family in all villages has cultivable land and most of them are dependent upon agriculture and allied activities for their livelihood. Major problems observed were the migration of local youth, lack of technical know-how, damage caused by wild animals, lesser knowledge about government incentives and schemes, lesser involvement of government agencies like KVK's in extension activities, etc. Horticultural crops are mostly confined to the kitchen garden only. Hence, a Horticulture based Agri-entrepreneurship model was formulated to generate employment by employing more youth power in villages itself, as the post COVID era is going to provide a great opportunity in grasping the effect of reverse migration. This can be achieved by the active participation of the youth of the villages, Government and Non-Government organizations like KVK's, SAU's, and Co-operative societies, etc. These organizations need to work on an actual ground basis in the context of technology transfer and extension for overall rural development through agricultural transformations and promotion of these types of Agri-entrepreneurship models.

Keywords: Agri-entrepreneurship, Horticulture, Migration, Post- COVID era and Reverse migration.

PERFORMANCE EVALUATION OF TRACTOR OPERATED GUN SPRAYER ON COTTON CROP

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Cotton popularly known as “White gold” is the principal commercial crop and widely cultivated across India. Now a days, various insects like thrips, white fly etc. creating major problem in the production of the cotton. There are many types of sprayers available in the market for the better application of pesticides in the crop. Tractor operated gun sprayer operated with P.T.O. shaft of tractor was evaluated in laboratory as well as in the field conditions. The sprayer consisted of 500 liter polyethylene tank, pump (piston type), a gun type nozzle and arrangement for bundling the pipe. To select suitable operational parameters the sprayers were initially evaluated at three pressure levels and three heights and corresponding discharge, spray angle, swath width and spray distribution pattern were observed under laboratory conditions and the optimized value of pressure and target height were selected for the evaluation of the sprayers in field conditions. At laboratory condition, minimum coefficient of variation (%) throughout swath of spray was found at the pressure of 15 kg/cm² and at the standard height. To select these figures we performed the experiment on the cotton crop. Under field conditions, the number median diameter, volume median diameter, uniformity coefficient, mean area covered by droplets and droplets density were found 60.73 µm, 213.18 µm, 3.60, 23.74 mm²/cm², and 80 droplets/cm², respectively. The actual field capacity was 0.82 ha/h at the field efficiency of 78.63%. The cost of operation, B:C ratio, break-even point and pay-back period were 504 Rs/ha, 1.98, 52.77 h/yr and 0.34 yrs, respectively. Tractor operated gun sprayer is a good sprayer technology and showed best results in terms of uniformity, droplets size, area covered by droplets, volume of spray deposition, bio-efficacy, cost of operation and field capacity.

Keywords: White fly, gun sprayer, pump, spray.

EFFICIENT MANAGEMENT OF WATER TO MITIGATE METHANE EMISSION FROM PADDY FIELDS

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The second largest greenhouse gas next to carbon dioxide (CO₂) is methane (CH₄). Methane is primarily produced from rice fields. Globally, it is estimated that about 19% of anthropogenic methane emissions comes from rice fields (Chen and Prin, 2006). The first evidence that methane concentration in the earth's atmosphere is continuously increasing was presented by Graedel and McRae. The major source of methane emission to atmosphere is agricultural submerged rice soils. The second most potent greenhouse gas i.e., methane is emitted under anaerobic condition by the activity of methanogens in rice soils. Rice is the second most consumed crop in world next to corn and out of total rice 90% is cultivated under continuous standing water condition which creates a favourable environment for the growth of anaerobes that can thrive well in absence of oxygen. Efficient management of water in rice field is the most important strategy for mitigating the methane emission in rice field. Aerobic rice is a new method of growing rice that needs less water as compared to low land rice. It is a production system where rice is grown in well drained, non-puddled and non-saturated soils. Water management practices like alternate drying and wetting, midseason drainage, SRI are some of the effective tools for minimizing methane emission from rice fields.

Keywords: Methane, carbon dioxide, anaerobic, aerobic rice

DEVELOPMENT AND PERFORMANCE EVALUATION OF HYBRID SOLAR TUNNEL DRYER FOR PRODUCTION OF QUALITY RAISINS AMBRISH GANACHARI^{1*}, UDAYKUMARNIDONI², MATHAD PF³ AND NAGARAJ NAIK⁴

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In the present investigation, a hybrid solar tunnel dryer was developed realizing the demand for large capacity commercial units utilizing different energy sources for better moisture removal. A 5000 kg solar tunnel dryer was developed for dehydration of grapes by utilizing the solar energy (heat and photovoltaic) and fuel energy for improving the drying time. The dimensions of the developed large capacity dryer were 28.0 m length, 5.8 m width and 2.1 m height with four shelves having four layers in each shelf for loading 5000 kg of grapes. The dryer was provided with electric heating system (2.41 kWh) energy to supplement heat during night and cloudy days. The air flow rate of blower was calculated to be 1090 m³/min for removal of evaporated moisture from the dryer. The performance evaluation of the dryer at full load condition recorded the drying time of 124 hours (5 days) for drying the grapes from 329.18 to 25.63% moisture content (d.b.) at an average drying temperature of 40°C. The average drying rate was 0.03 kg/h/kg of dry matter. The quality characteristics viz., TSS, acidity, water activity and reducing sugars were recorded to be 55-58° brix, 1.9%, 0.51 and 63.8%, respectively. The colour values (*L**, *a** and *b**) of the dried grapes were 38.14, 15.56 and 28.60, respectively representing bright greenish colour and acceptable for export and commercial trade.

Keywords: Solar drying, Large capacity solar dryer, Hybrid dryer, Grape drying

SEED PRETREATMENTS ENHANCED GERMINATION AND PLANT GROWTH IN *Ocimumtenuiflorum*L.

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The effect of seed pretreatments on germination and plant growth responses of *Ocimumtenuiflorum* was investigated in the study. The primary aim of seed pretreatment was to enhance germination and improve growth, seedling vigour and subsequently enhance plant growth and yield. The seeds were exposed to different pretreatments viz., sand paper scarification, water soaking (overnight), hot water (65°C for 10 min) and concentrated H₂SO₄ (1 min). The seeds were then sown in protrays to study their effect on seed germination and subsequently transplanted to growbags to study their effect on plant growth and yield. The seeds exposed to sulphuric acid recorded maximum germination of 85.33 per cent. The seedlings obtained from the seeds exposed to hot water treatment recorded the highest shoot length (17.17 cm), root length (10.66 cm) and seedling length (27.83 cm) which was observed to be on par with scarification and water soaking treatment. The various pretreatments tried had no significant influence on allometric index. Seedlings derived from hot water treated seeds recorded the highest seedling vigor index (19.67) which was on par with water soaking and con. H₂SO₄. On transplanting, plants raised from hot water treated seeds subjected to hot water treatment, sand paper scarification and water soaking recorded significantly higher plant height and number of branches. At harvest, hot water treatment recorded the highest shoot biomass, which was on par with scarification and water soaking treatments. The seeds subjected to sandpaper scarification, hot water and water soaking treatments, though registered, a lower germination per cent, recorded better seedling growth in terms of seedling length. The same treatments gave good plant growth and biomass yield at harvest. It could be concluded that initial phase of seedling development would reflect on the final yield of the crop rather than the germination per cent.

Keywords: *Ocimumtenuiflorum*, pretreatments, sulphuric acid, hot water treatment, shoot biomass

EFFECT OF CADMIUM INDUCED STRESS ON MORPHOLOGICAL AND BIOCHEMICAL CHANGES IN RICE PLANT (*Oryza sativa* L.)

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A pot experiment was carried out to assess the adverse effect of cadmium induced stress on morphological and biochemical changes in rice plant on plant height (PH, cm), number of tillers (NT), number of leaves (NL), leaf area (LAcm²), leaf area index (LAI), crop growth rate (CGR, mg cm² day⁻¹) Chlorophyll content (SPAD unit) and nitrogen content (%). As per the intensity or concentrations of cadmium increase from 100ppm to 300 ppm, all the morphological parameters

including biochemical parameters were started to reduce their growth. However, as per the advancement of age, the growth was increased in each and every parameter. The maximum number of tiller, NL, LA, LAI hill⁻¹, and chlorophyll in term of SPAD unit and nitrogen content were recorded at 75 DAS while the PH and CGR was recorded at 100 DAS and between 50-75 DAS respectively. The overall percent reduction among the control and highest level of cadmium toxicity (HLCT i.e. 300 ppm) at the peak stage were recorded as PH (18.48%), number of tiller (39.84%), NL (25.45%), LA (22.87%), LAI hill⁻¹ (22.94%), CGR (26.79%), SPAD unit (24.60%), and nitrogen content (24.44 %) respectively.

Keywords: Cadmium, CGR, LAI, Nitrogen content, SPAD unit.

EFFECT OF PRE-EMERGENCE AND POST-EMERGENCE HERBICIDES ON GROWTH AND YIELD OF CHICKPEA AT DOON VALLEY OF UTTARAKHAND

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A field experiment was conducted during Rabi season 2017-2018 at Doon (P.G.) College of Agriculture Science and Technology, Selaqui, Dehradun (Uttarakhand) were four herbicides, integrated with hand weeding applied where evaluate for efficacies of the herbicides on controlling weeds, their influences on yield and production economics on Chickpea (*Cicerarietinum*L.) variety was Pant Gram-186. The dominant weed species among monocot weeds were *Phalaris minor*, *Cynodondactylon*, *Brachiariamutica* and *Cyperusrotundus* and among the dicot weed species *Chenopodium album*, *Medicago denticulate*, *Convolvulus arvensis*, *Melilotusindica*, *Parthenium hysterophorus* were observed during growing season. Weed dry weight of monot and dicot weed was the lowest by hand weeding carried out 25 and 45 DAS. Maximum weed control efficiency was observed with interculturing was followed by hand weeding at 25 and 45 DAS. This treatment also recorded higher yield attributes and seed and stover yield (1761 kg ha⁻¹ and 2245 kg ha⁻¹) and maximum net monetary returns and Benefit :Cost ratio (Rs 34076 and 1.88, respectively).

BIOLOGY AND CONTROL OF RICE MOTH, CORCYRACephalonica(LEPIDOPTERA :PYRALIDAE) BY USING BOTANICALS HARMINDER SINGH

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Corcyracephalonica is a secondary pest of stored grains like wheat, maize and rice. The biological studies revealed that the life cycle of rice moth passed through four different stages i.e. egg, larva, pupa and adult. The egg duration ranged from 3-5 days. The larva passed through six instars and the average duration (days) of each instar was found to be 4.88±0.7, 4.48±0.7, 3.96±0.7, 3.70±0.6, 3.76±0.8 and 10.04±0.7 days respectively. The longevity of females was higher 4.24±0.9 days than the males 3.52±1.0 days. The average pupal period was 11.34 days. Powdered leaves of *Ocimumtenuiflorum* (Lamiaceae) and *Eucalyptus globulus* (Labill.) (Myrtaceae) were tested for their efficacy against the stored grain insect pest *C. cephalonica*. At the higher measurements of 2.5 and 3.5 g of *Ocimumtenuiflorum* and *Eucalyptus globulus*, it was more successful and shows 100% mortality of second instar larvae of rice moth. When looked at both plant leaf powder against rice moth larvae, *E. globulus* leaves indicated a marginally higher mortality rate than *O. tenuiflorum*.

Keywords: *Corcyracephalonica*, biology, maize, Egg.

A STUDY ON EFFECTS OF DIFFERENT INSECTS ON STORED GRAINS IN PUNJAB REGION

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Agriculture sector play a great role in the economy of the country as it caters to the feeding needs of a large population. Punjab is called the “Granary of India”. The state has a total cultivable area of 4.2 mn ha and with area , Punjab produces 18% of wheat,12% of rice,10% of milk,20% of honey,48% of mushroom and 5% of cotton in the country. According to the data provided by the Union Ministry of consumer Affairs , food and public distribution in Parliament stored food grain damage is accounted with a sharp increase of 8 tonnes, 11 tonnes, 311 tonnes in the years 2016-17,2017-18,2018-19 respectively. Different factors are responsible for damaging the stored grains like temperature ,humidity, moisture, insects, pests ,rodents. Out of all insects play an important role in damaging the stored grains and low level of production. A study is being conducted to know about the different types of insects like *Sitophilus oryzae* (L.), *Rhyzoperthadominica* (F.), *Sitotrogacerealella* (Ol.), *Triboliumcastaneum* (Hbst.) ,their production rate and effects on stored grains in Punjab and proposing a suitable mathematical model for damaged grain.

Keywords: Grain damage, population growth rates, storage losses, stored grain insect pest species

STUDIES ON STANDARDIZATION AND QUALITY EVALUATION OF RTS BEVERAGE FROM MUSKMELON (*Cucumis melo* L.) VARIETY SARDA

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Ready-to-Serve beverage (RTS) was prepared from muskmelon variety “Sarda”. RTS studied as nectar is a value-added product that was developed from *Cucumis melo* L. which was further subjected to physicochemical analysis and organoleptic evaluation during a storage period of 90 days. The result of research study showed an increasing trend in pH, total soluble solids, total sugars and reducing sugars while there was a declining trend in acidity, ascorbic acid and non-reducing sugars noticed during the storage period of muskmelon RTS (nectar). Muskmelon nectar prepared with the formulation of 15% pulp and 10°Brix total soluble solids was rated superior for overall acceptability during the 90 days storage period.

Keywords: RTS, value-added product, overall acceptability, nectar.

AIR POLLUTION TOLERANCE OF PLANTS

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Air pollution is the major havoc these days. Air blended with non-bearable substances has endangered the life on this planet earth. The air mixed with harmful and toxic substances is dominating earth’s atmosphere and knocking out almost every life on the planet. Scientific techniques have proved insufficient to ameliorate industrial air pollution but none better than plantation and green vegetation. Plants growing near the industrial area absorb the pollutants and dust particles on their leaf surfaces, but after prolonged exposure they show symptoms of

morphological and physiological damaged. In order to assess the changes inside the plant, four biochemical parameters namely ascorbic acid, pH, chlorophyll and relative water content were determined and computed together in the formula of Air pollution tolerance index (APTI). APTI is used to evaluate the response of plants towards air pollutants and depending upon the APTI value we considered the plant is tolerant or sensitive. In the present study, an attempt has been made to study the plant species for greenbelt development around Gangyal industrial area of Jammu. Leaf samples of different plant species namely *Musa acuminata*, *Aegle marmelos*, *Psidium guajava*, *Ziziphus mauritiana*, *Syzygiumcumini* were taken around industrial area; sampled in polythene bags during morning hours; tagged and brought to the laboratory immediately after sampling and analysed for biochemical parameters. The susceptibility level of plants to air pollutants, as indicated through their APTI values. The APTI value < 10 is considered sensitive; within 10-16 is considered as intermediate and if > 17 is considered as tolerant. Among the studied plants species, *Psidium guajava* has recorded high APTI value 8.3 and *Musa acuminata* has minimum APTI value 5.9. Thus, *Psidium guajava* is comparatively more tolerant than other selected plant species. Studied plants species possessed air pollution tolerance index values < 10 are considered as sensitive and they can be used as bioindicators for monitoring the air quality of industrial area.

Keywords: Air Pollution, APTI

WEED MANAGEMENT IN CHICKPEA (*Cicer arietinum* L.) AT DOON VALLEY CONDITIONS

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A field experiment entitled "Weed management in Chickpea (*Cicer arietinum* L.) under Doon valley condition" was conducted during *rabbi* season 2017-18 at, Doon (P.G.) College of Agriculture Science and Technology, Selaqui, Dehradun (Uttarakhand). The experiment was carried out in Randomized Block Design with three replications. The treatments consist of eleven weed management practices. We observed Weed free up to 60 days recorded minimum and significantly lowest total weed counts compared to rest of treatment then One hand hoeing at 15 DAS + one hand weeding at 30 DAS (T_9), Pendimethalin 30 EC Pre-emergence @ 0.700 kg a.i. $ha^{-1}fb$ then one hand weeding at 30 DAS (T_2), Pendimethalin 30 EC PE @ 700 g ha^{-1} , (T_1). Weed index was recorded highest i.e 100 per cent with treatment Weed free up to 60 days. The important growth attribute *viz.*, plant height, number branches $plant^{-1}$, crop dry matter accumulation and important yield contributing characters *viz.*, number pods $plant^{-1}$, number of seeds pod^{-1} , text weight, growth values *viz.*, grain and straw yield significantly in in the treatment Weed free up to 60 days and it as at per with One hand hoeing at 15 DAS + one hand weeding at 30 DAS (T_9), Pendimethalin 30 EC Pre-emergence @ 0.700 kg a.i. $ha^{-1}fb$ then one hand weeding at 30 DAS (T_2), Pendimethalin 30 EC PE @ 700 g ha^{-1} , (T_1). Economic study revealed that, the maximum net monetary returns were obtained with the treatment Weed free up to 60 DAS (Rs 40758 ha^{-1}) but it was at per with treatment One hand hoeing at 15 DAS + one hand weeding at 30 DAS (T_9), (Rs 29770 ha^{-1}), Pendimethalin 30 EC PE @ 700 g ha^{-1} , (29429 ha^{-1}), Pendimethalin 30 EC Pre-emergence @ 0.700 kg a.i. $ha^{-1}fb$ then one hand weeding at 30 DAS (T_2), (Rs 27361 ha^{-1}). Where, B:C ratio (2.20) is highest in also with the treatment Weed free up to 60 DAS.

Keywords: Chickpea, Weed management, weed index

DOCKING STUDY OF FLT3 RECEPTOR WITH TYROSINE KINASE FOR LEUKEMIA DISEASE

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RCSB PDB resource is powered by the protein data bank archive information about the 3-D shapes of proteins, nucleic acids, & a complex assembly that helps students and researchers understand all aspects of biomedicine and agriculture, from protein synthesis to health and disease PDBsum –a pictorial database that provides an at a glance overview of the contents of each 3-D structure deposited in the protein data bank. Shows molecules make their structure and schematic diagrams of their interactions. More use of the RasMol program to view molecules and their interactions. KEGG pathway database is a resource that integrates genomic, chemical, and systemic functional information. Kegg has expanded more applications on human disease, drugs, etc. Zinc databases are a commercially available compound for structure-based virtual screening. Drug bank databases are comprehensive freely accessible online databases containing information on drugs and drug targets. The latest release of the databases contains 7677 drug entries including 1558 FDA approved small molecule drugs, 155 FDA –approved biotech drugs, 87 nutraceuticals, and over 6000 experimental drugs. Its entry contains more than 200 fields in which half information is of drug and half information is of drug target. HMBD, T3BD, SMPD, and FooDB are also part of a general suite of metabolic databases. Binding databases are public, web-accessible databases of binding affinities that focus on the interaction of proteins considered to be drug targets with a small, drug-like molecule. Applications include drug discovery, molecular modeling, and nanotechnology. Autodock tools is a suite of automated docking tools, designed to predict how small molecules like substrates bind to a receptor of 3-D structure. Docking is a method that predicts the preferred orientation of one molecule to a second when bound to each other to form a stable complex. Lipink's rule of five also known as Pfizer's rule of five is a rule of thumb to evaluate drug likeliness or determine if a chemical compound with certain pharmacological or biological activity has properties that would make it likely orally active drug in humans. It states in general an oral drug has no more than one violation of the following criteria no more than 5 hydrogen bond donors, no more than 10 hydrogen bond acceptors, a molecular mass less than 500 daltons, an octanol-water partition coefficient that does not exceed 5.

SCRUTINIZING THE PROPOLIS COMPONENTS IN THE DEVELOPMENT OF ECONOMIC NOVEL THERAPEUTICS FOR COVID-19

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The emerging coronavirus disease (COVID-19) swept across the world, affecting more than 200 countries and territories. The effect of SARS-CoV-2 on humans is clearly age related. So far, very few deaths from COVID-19 have been recorded in people under the age of 20, while the elderly have high mortality rate. We hypothesize that, the increased sensitivity to coronavirus in the elderly is due to their reduced immunity. Propolis is a natural resinous mixture produced by honeybees. The

presence of carboxylic acid, terpenoids, steroids, hydrocarbons, sugars, alkaloids, flavonoids, phenols, ketones, amino acid, vitamins, volatile oils and other compounds fortifies its nutraceutical value. Its formulations have been already utilized for cold syndrome (upper respiratory tract infections, common cold, and severe flu-like infections), as well as dermatological preparations useful in wound healing, treatment of burns, acne, herpes simplex and genitalis, and neurodermatitis. Thus, exploring propolis components for immunity building and the development of novel therapeutics for covid-19 can be an economically feasible option worldwide.

Keywords: COVID-19, Pandemic, Propolis, Nutraceutical value, Honeybees

EFFECT OF DATES OF SOWING ON DEVELOPMENT OF LINSEED WILT CAUSED BY *Fusariumoxysporum f. lini*(BOLLEY) SNYDER & HANSEN

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Development of Linseed Wilt caused by *Fusariumoxysporum f. sp. lini* (Bolley) Snyder & Hansen was studied by manipulation of dates of sowing of the crop. The crop was sown at ARI, Patna farm in RBD with three replication. Five dates starting from October, 1st at 15 days intervals were taken with test variety T-397. Out of the different five dates, the maximum disease incidence per cent i.e. 31.43% was found in October 1st sown crop with lowest yield of 3.09 q/ha. The incidence of the disease was decreased with the advancement of the dates of sowing and the crop sown on November, 30th received lowest disease incidence percentage of 10.86%. In comparison with the yield component, the crop sown on October, 31st gets highest yield of 6.69 q/ha. Although the later dates sown crop received lowest disease incidence percentage but simultaneously yield was not increase which might be due to delay in maturity and small & less number of formation of capsules.

Keywords: Linseed, Wilt, Disease Incidence, dates of sowing

TISSUE CULTURE TECHNIQUE: A POTENTIAL TOOL FOR SUGARCANE VARIETAL DEVELOPMENT IN SUBTROPICAL CONDITION

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Sugarcane is a tropical crop. It flowers profusely in tropics and the climatic condition is suitable for seed setting in sugarcane. In subtropics sugarcane has to face extreme of high temperature in May-June and extreme of low temperature in December-January. In subtropics few cultivated varieties flower in late November and after its opening of flowers temperature rapidly goes down due to which either the pollen become non-viable or there is no seed setting. In such a condition conventional method of hybridization does not work and soma clonal variation become the only

option. Through somaclonal variation variability is created and after due selection variety is developed. Sugarcane varietal development can be done through mass multiplication of newly developed clones through micropropagation. Micropropagation provides true to type, disease and insect pest free plantlets in millions from a single shoot apex. The plantlets obtained from tissue culture are free from nutritional disorder and so there is possibility of 10-15 % increase in yield and upto 0.5% increase in sucrose content. A newly developed and released variety can reach to the farmers field in only 2-3 years in comparison to conventional method which takes 10 years and more. Tissue culture technique is also helpful in conservation of germplasm at ultra low temperature i.e cryopreservation. Many somaclones have been developed through tissue culture technique having disease elimination and elimination of other unwanted characters.

Keywords: Sugarcane, somaclonal variation, tissue culture, subtropical Condition

VARIABILITY AMONG ISOLATES OF SUGARCANE RED ROT PATHOGEN CAUSED BY *Colletotrichum falcatum* WENT.

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Sugarcane crop is affected by several biotic and abiotic factors, in which red rot disease caused by *Colletotrichum falcatum* Went. is considered as a very dreadful and serious problem in Bihar as well as different states except few parts of country and its importance is well established in the production, productivity as well as quality. The disease is responsible for the destruction and wiping out of the several popular Sugarcane varieties from cultivation. The main cause may be the emergence of the new pathotypes in the red rot pathogen and the presence of different pathotypes in specific or different cane growing areas. Pathogenic variability among isolates of red rot pathogen is essentially required for varietal evaluation testing programme. Thus, the present study was worked out to know the variability among the isolates of red rot pathogen in Bihar. In variability study, a differential interchange among the host varieties and isolates of red rot pathogen was noticed. Ten sugarcane host differentials were inoculated with two designated pathotypes CF07 and CF08 and twelve isolates collected from various locations of cane growing areas of the state. On the basis of observations made during last three years (2016-2018), host differentials Co1148 and Khakai showed susceptible reaction, whereas BO91 and SES594 showed resistant reaction, while, host differentials Co419, CoS 8436, Co62399, Co 975, CoV 92102 and CoSe 95422 produced differential reaction against all the test isolates.

Keywords: Sugarcane, red rot, Variability, isolates, host differentials.

PHYSIOLOGICAL STUDIES OF *Sclerotiniasclerotiorum*(LIB.) DE BARYCAUSING STEM ROT OF OILSEED BRASSICA

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The *in vitro* studies indicated that *Sclerotiniasclerotiorum*(Lib.) de Bary causing stem rot of oilseed brassica grew at all the temperatures tested. Significantly maximum growth (77.00 mm) was recorded at 20°C temperature which was found at par with 25°C (72.6 mm) as was followed by 15°C (55.80 mm) after 4 days of incubation. While minimum radial growth of mycelium was recorded at 10°C (38.40 mm). Maximum number (44) of sclerotia per plate was recorded at 20°C which followed by 25°C and 15°C with 40 and 31 sclerotia respectively. The pathogen tolerate a wide range of pH. Good growth and sclerotial formation was recorded between pH 4.5 to 5.5. pH. The pH 5.0 was found to be ideal and produced the maximum dry mycelium weight (196.8 mg) followed by pH 4.5 and 5.5 which yielded 182.6 mg and 159.3 mg dry mycelium weight per flask, respectively. Significantly maximum number of sclerotia were formed at pH 5.5 (32.7) after 14 days of incubation at 25±1°C temperature.

Keywords: Oilseed brassica, Stem rot, *Sclerotiniasclerotiorum*, Physiological Studies.

EFFECT OF NON-MONETARY INPUTS ON THE PERFORMANCE OF RABI CORN (*Zea mays* L.) HYBRIDS

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A Field experiment was conducted at BCKV, West Bengal during winter (*rabi*) season of 2014-15 and 2015-16 to know the effect of non-monetary inputs on the performance of *rabi* corn (*Zea mays* L.) hybrids. The objective of the study were to standardize proper planting density and planting date for attaining potential yield under irrigated conditions. The experiment was laid out in split factorial design with 3 replications having 27 treatment combinations. Results revealed that taller plants with greater LAI were produced when the crop sown early on Nov. 20 (4.8 and 10.3% more than the crop with delayed sowing on Dec. 10). Compared to lowest density of 55,555 plants/ha, the extent of increase was 5.6 and 9.5% for plant height, 34.9 and 45.4% for LAI, and 4.6 and 9.5% for DMA in year 1 and year 2, respectively. The delayed planting (Dec. 10) caused significant reduction of yield components and it was to the tune of 14.1 and 8.6% for cob length, 7.2 and 4.3% for cob girth, and 3.5 and 10.1% for 1000-grain weight in year 1 and year 2, respectively. Increased plant density (83,333 plants/ha) caused significant reduction in yield components to the tune of 4.4 and 7.4% for cob length, 2.0 and 7.2% for cob girth and 7.3 and 6.5% for 1000-grain weight in year 1 and year 2, respectively. Irrespective of all tested hybrids, the significantly higher grain yield was registered when the crop sown early on Nov. 20, and it was

decreased by 44.8 and 7.9% when the sowing was delayed upto Dec. 10 in year 1 and year 2, respectively and the crop sown at a density of 83,333 plants/ha, accounting 86.8 and 79.4% more than the crop sown at a density 55,555 plants/ha in year 1 and year 2, respectively. Summarizing all the above findings, it is understood that the sustainable productivity of maize could be achieved through maintenance of proper sowing time and optimum plant population. Thus, it can be inferred that sowing of maize hybrids on 20 November at a density of 83,333 plants/ha (60 cm × 20 cm) can be recommended as a crop management practice to sustain maize production in winter (*rabi*) season under West Bengal condition.

Keywords: Cob length, cob girth, Dry matter accumulation (DMA) and Leaf Area Index (LAI)

EVALUATION OF THE PHYSIOLOGICAL PARAMETERS OF THE WORKERS OF DIFFERENT AGE GROUPS OPERATING THE LINSEED THRESHER AT DIFFERENT MOISTURE LEVEL OF CROP

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A study was conducted on “evaluation of the physiological parameters of the workers of different age groups operating the linseed thresher at different moisture level of crop”. Physical properties of linseed plants were determined. Physiological parameters, heart rate, oxygen consumption rate and energy expenditure rate of age group operators of (20-24, 25-29, 30-34, 35-39 and 40-44 years) were determined during working on linseed thresher at different moisture level of sample of linseed crop. Heart rate, oxygen consumption rate and energy expenditure rate were increasing when age groups increased at moisture level of sample (15%, 20%, 25% MC). Heart rate, oxygen consumption rate and energy expenditure rate of 20-24 yrs age groups were found minimum during working on thresher at different moisture levels. Heart rate, oxygen consumption rate and energy expenditure of age group operator of 40-44 yrs were found maximum as same.

Keywords: Ergonomic, Linseed crop, Physiological, Parameter and Moisture level

MODIFIED AMMI MODEL FOR SELECTION OF MANGO GENOTYPES IN PRESENCE OF BIENNIALITY

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Mango is the most important perennial fruit crop not only in India but also in the world. Most of the perennial crops and mango too, exhibit bienniality in fruiting. Due to this phenomenon mango growers face economic risk. The presence of bienniality is a challenging problem in selecting stable genotypes in addition to the genotype-by-environment interaction using Additive Main effect and Multiplicative Interaction (AMMI) model in Multi-Location Trials (MLT's) data. In this paper an attempt has been made to modify the AMMI model to tackle the problem of bienniality. Also, the

performance of stability measures and indices meant for simultaneous selection of genotypes for yield and stability using the modified AMMI model in the presence of bienniality has been assessed through simulation study in mango crop and validated on real data. Ranking pattern of the genotypes has been studied under two situations, namely, MLT's data with bienniality and MLT's data without bienniality. Results revealed that there were changes in ranking of genotypes after eliminating bienniality from the data. Hence, it is recommended to use modified AMMI model to select the stable genotypes for the breeding programme in the presence of bienniality. Also, in the process of releasing of mango varieties bienniality should be eliminated from the data.

Keywords: Multi-Location Trials, Genotype \times Environment Interaction, Stability, Bienniality.

COMPARATIVE ECONOMIC EVALUATION OF PRODUCTION AND RESOURCE USE EFFICIENCY OF SUGARCANE CROP IN WEST CHAMPARAN DISTRICT OF BIHAR

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The focus of the present study was on economic evaluation of production and resource use efficiency in West Champaran district of Bihar. A sample size of 68 sugarcane growers was selected using random sampling method and data were elicited through survey method. The technique of tabular and functional analysis were employed. The study has shown that the maximum net returns were found under planted (RS. 101298.62/ha) followed by ratoon crops (Rs. 68784.35/ha) respectively. Returns per rupees of investment was found to be highest in planted crop (2.23), followed by ratoon crop (1.99) respectively. The almost resource input were found were found significant at 1% and 5% level of probability except human labour and tractor cost used indicating that these resources were being used at sub-optimal levels and there exists the possibilities of enhancing the yield of sugarcane by increasing their use. Therefore, ratoon sugarcane was more remunerative and yield can be sustainable and if reduce the growers to go for rationing continuously and adopted a proper package of practices will be followed.

Keywords: Sugarcane, Costs of returns, resource use efficiency, Bihar

ESTIMATION OF HETEROSIS AND INBREEDING DEPRESSION OR SEED YIELD AND DISEASE RESISTANCE IN LINSEED (*Linum usitatissimum* L.)

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A study was conducted for the estimation of heterosis and inbreeding depression involving five parents and their six F₁s and six F₂s for seed yield, morphological traits and incidence of diseases in linseed. Estimates of heterosis revealed that all the six crosses showed significant and desirable

heterosis over check variety for seed yield per plant, number of capsules per plant, capsule diameter and test weight. For wilt disease, the heterosis over mid-parent, better parent and standard check was found to be significant and negative in four crosses while rust disease showed significant and negative heterosis in three crosses. Inbreeding depression in F₂ generation was estimated in all the six crosses for the characters under study. The character test weight showed positive significant inbreeding depression in five crosses of F₂ generation. The inbreeding depression was significant and negative for both wilt and rust diseases in four and all the six crosses respectively.

Keywords: Linseed, Heterosis, Inbreeding Depression, Disease Resistance.

HYPERACCUMULATOR PLANTS: ITS POSSIBLE USE FOR AGRICULTURAL DEVELOPMENT

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Hyperaccumulator plants are species of plants that tend to tolerate the effects of heavy metals or plant species that accumulate a large number of metals in them. These plant species do not affected by heavy metals or stress conditions. Phytoremediation technique is a plant-based technology, which uses plants for the extraction of heavy metals from contaminated zones. This technique is very cheap than other methods of remediation. As well as this also increases the aesthetic value, cleans the environment by not causing any pollution and harm to the soil, water and environment. These plant species can also accumulate more than one metal in them. Hyperaccumulator plant species are mainly used in serpentine soils and may accumulate various heavy metals, which is why these plant species are also known as Metallophytes. Plant species belonging to the Brassicaceae, Euphorbiaceae, Asteraceae family are used for hyperaccumulation. Plants such as *Arabidopsis thaliana*, *Berkheyacoddii*, *Pteris vittata*, *Helianthus annuus* are used for the extraction of soil metals, water and phytomining. Besides, many fungus-like species and algae species are also used for the extraction of heavy metals from the soil and water. Basidiomycetes and Ascomycetes are groups, which are mainly used in the process of mycoremediation viz., *Pleurotus* spp., *Agaricus* spp., *Lentinula* spp. In addition to the extraction of heavy metals, these species also contribute to the degradation of many compounds, such as plastic materials and PAHs.

Keywords: Agriculture, Biotic, Cadmium, Density, Economy, Forage

EFFECT OF DIFFERENT HERBICIDES ON WEED DYNAMICS AND PRODUCTIVITY OF CHICKPEA (*Cicer arietinum*)

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A field experiment was conducted at BAU farm, Sabour, Bihar, India during 2019-20 to evaluate the effect of herbicides on weed dynamics and productivity of chickpea. Ten treatments consisted with eight herbicidal treatments, pre-emergence application of pendimethalin 1000 g/ha, oxyfluorfen 150

g/ha; post-emergence application of quizalofop-ethyl 50 g/ha, imazethapyr 50 g/ha, propaquizafop 25.2 g/ha, topramezone 40 g/ha individually and two of different herbicidal combinations as imazethapyr + imazamox (Readymix) 60 g/ha (PoE) and clodinafop-propargyl + na-aciflurofen (Readymix) 220 g/ha (PoE) along with two hand weedings at 30 & 50 DAS and weedy check, were tested in randomized block design with three replications. Two hand weedings recorded significantly reduced weed density and weed dry matter at 60 and 90 DAS with WCE of 91.73 & 93.60 % at 60 & 90 DAS respectively and was similar to use of topramezone 40 g/ha. Post-emergence application of topramezone (40 g/ha) resulted in maximum plant height (54.22cm at harvest), number of branches/plant (21.77), number of pods/plant (48.86), test weight (21.62g), grain yield (1.63 t/ha), gross return (Rs. 79,560/ha), net return (Rs. 47,404/ha) and B:C ratio (1.47) compared to other herbicide applications. So, the application of topramezone as post-emergence (40 g/ha) was as good as two hand weedings (At 30 and 50 DAS) for better weed control, higher crop yields and benefits.

Keywords: Chemical control, hand weeding, herbicide combination, weed control, efficiency, chickpea.

ROLE OF TRADITIONAL AGROFORESTRY IN LOCAL FOOD SECURITY IN ARUNACHAL PRADESH, INDIA

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The indigenous people inhabiting the hilly terrains of Arunachal Pradesh, India, are associated with both traditional agroforestry and *jhum* cultivation for ages. These practices are found to be managed indigenously and believed to have been evolved by farmers through trials and errors for generations. The present traditional agroforestry practices in the state have transformed from *jhum* practices which have lost its popularity in recent times. One of the reasons behind is low crop yield due to the shorter cycle of *jhumming* (shorter fallow period) which leads to soil erosion. Adoption of agroforestry by the tribal people had led to the upliftment of livelihood and socio-economy by providing a year-round production and a way to generate income. It also plays a significant role in local food security as most of the people inhabiting the remote areas of the state are directly or indirectly dependent on agricultural and forest products for their survival. Traditional agroforestry practices also allow domestication of wild edible and valuable medicinal plants in natural conditions. A preliminary study was carried out in Namsai, Lower Dibang Valley and East Siang districts of Arunachal Pradesh to assess the implications of traditional agroforestry practices in relation to local food security, socio-economy, and the constraints in adoption of the practice. A total of 135 crop-plants species grown in traditional farming systems were recorded which also includes economically important medicinal and domesticated wild edible plants species. The study sites were largely inhabited by the Adis, the Deoris, the Sonowal-kacharis, the Tai-Khamptis, and the Mishmi tribe. The major constraints hampering the adoption of agroforestry systems were documented along with the status of food security in the study sites. Major components of traditional agroforestry systems and tree-crop combination for different climatic zones in the study area were also studied.

Keywords: Indigenous tribe, Traditional agroforestry, food security, socio-economy and livelihood, Arunachal Pradesh

EFFECT OF REFRIGERATED AND ROOM STORAGE CONDITIONS ON POST HARVEST QUALITY OF BROCCOLI VAR. SADHANA

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Broccoli cultivation was conducted during 2012-13 and 2013-14 at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal while the laboratory work was conducted in the department of Post Harvest Technology of Horticultural Crops, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia with the objectives to compare the shelf life of broccoli stored in room condition and refrigerated condition with different form of packaging material since broccoli is a highly perishable product so that the produce may be available in the market for a longer period of time. The broccoli were grown with three dates of sowing at 15th September, 30th September and 15th October and harvesting of broccoli heads at three head diameters of $\geq 12 < 14$ cm (small), $\geq 14 < 16$ cm (medium) and above 16cm (large) diameter. Packaging was done in 4 treatments: T₁ - Without any packaging material, T₂ -Polypropylene bag with 1% perforation, T₃ -Polypropylene bag with 2% perforation, T₄ -Polypropylene bag without perforation. Physiological loss in weight (%), ascorbic acid content (mg/100g), TSS(°B), chlorophyll content(μ g/g), yellowing (%), fungal decay (%), bacterial decay (%) and sensory evaluation for colour, smell, texture and browning (5 point Hedonic scale), marketability (%) were estimated following standard method of physico-chemical analysis at regular intervals during the storage period. Highest retention of ascorbic acid was found in 1%perforation in refrigeration, while chlorophyll retention was highest in non perforated packed for refrigerated condition, On sensory evaluation, non perforated pack gave best colour for all the storage conditions with the best score in refrigerated condition compared to other type of packages under all the storage conditions while smell score was good for all the unpack broccoli irrespective of storage conditions.

Keywords: Ascorbic acid, Broccoli, chlorophyll, Sadhana, perforation

CONSTRAINTS IN ADOPTION OF CAULIFLOWER AND CABBAGE PRODUCTION TECHNOLOGY

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India ranks second in vegetables production in the world. India produces 184394 thousand metric tons of vegetables from area of 10,259 thousand hectares with productivity of 17.97 MT/ha. (National Horticulture Board, 2017-18). Cauliflower and cabbage comes under Cole crops. The word Cole seems to have been abbreviated from the word "Caulis" meaning stem. Cauliflower (*Brassica oleracea* L. var. botrytis) is cool season vegetable grown for its white and tender curd. Vegetables are excellent source of vitamins, particularly niacin, riboflavin, thiamine and vitamins A and C. The study was carried out in Patna district. A total of 80 Cauliflower and Cabbage growers from two blocks were selected purposively. The interview technique was used for collection of data with the help of structured interview schedule. The study revealed that majority of cauliflower and cabbage growers were of middle age group (42.5 percent), upto secondary & higher secondary education (45.00 percent), backward classes (45 percent), medium family size (46.25 percent), marginal land holding (45.00 percent), medium economic motivation (62.50 percent), medium

market orientation (52.50 percent), medium farm mechanization (56.25 percent), medium annual income (78.75 percent) and medium contact with extension agency (58.75 percent). The main constraints responsible for the technological gap perceived by Cauliflower and Cabbage growers were lack of disease resistant varieties (68.75 percent), high cost of insecticides and pesticides (75.00 percent), lack of storage facilities (87.50 percent), sudden decrease in price at harvesting time (72.50 percent) and lowest constraints perceived by Cauliflower and Cabbage growers were less availability of irrigation water (35.00 percent).

FLOURIDE EFFECTS AND ITS IMPACT ON AGRICULTURAL CROPS: A REVIEW

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Water is an essential resource for living systems, industrial processes, agricultural production and domestic use. Occurrence of fluoride (F) in groundwater has drawn global attention as ingestion of water with fluoride concentration above 1.5 mg/L may result in dental or skeletal fluorosis. The maximum tolerance limit of fluoride in drinking water specified by the World Health Organization (WHO, 1984) is 1.5 mg/L. High fluoride concentration in the groundwater has been reported in many parts of Indian subcontinent and is becoming a serious concern for the drinking water supply. The recommended maximum concentration of fluoride for irrigation water is 1 mg L⁻¹ (National academy of sciences, 1972) and Pratt (1972). According to WHO (1984), the optimum range of F in soil is 2.57 to 16.44 ppm. The normal concentration of F in plant leaves usually ranged from 0.0001 to 0.015 mg kg⁻¹. The fluoride bioavailability was controlled by physical and chemical characteristics of the soil. Fluoride at high concentration in soils can cause various forms of toxicity to plants. *viz.*, the chlorosis of the tips and margins of older leaves followed by necrosis of the same areas, sometimes called burnt tips. Fluoride is phytotoxic to most plants influencing negative effect on crop production. So periodical measurement and control of the concentration of fluoride is very important to avoid both biological and environmental damage. High concentrations of F in soil may seriously threaten the life of plants, devastate soil microbial activity, disrupt the soil ecology, and cause soil and water pollution. Due to the high capacity of some plants for the uptake of F from soil the monitoring of soil F levels is necessary from time to time. In this review, we discuss the contribution of Flouride effects and its impact on agricultural crops.

Keywords:Flouride, Agriculture, Crops, Phytotoxicity

PRINCIPLES AND PRACTICES OF IRRIGATION MANAGEMENT FOR VEGETABLE CROP PRODUCTION

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A good water management planning must include the source as well as sink in terms of irrigation water and water-use. It is essential to understand the difference between crop and irrigation requirements. The crop water requirements signify the actual water required for growth and development of plant along with evapotranspiration (ET), which generally depend on climatic conditions. On the other hand, irrigation requirements refer to overall water requirement including crop water requirements and other losses that occur during irrigation which depends on soil type, structure and texture, management practices, characteristics of the irrigation system. The best management practices (BMP) for crop production focuses on the nutrient management through application of optimum fertilizer rates. As we know, water act as medium for the movement of off-site nutrient such as nitrate, phosphate and other soluble chemicals present in soil in the form of solution or sediments, therefore proper irrigation either through rainfall or irrigation supply system directly improves the efficiency of BMP plan. Hence it is important to discuss the basics of water use and irrigation management for vegetable crops, along with emphasis on different irrigation systems.

Keywords:Evapotranspiration, Best management practices, Water use efficiency

GREEN NANO TECHNOLOGY FOR ENVIRONMENTAL SUSTAINABILITY

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Green Nanotechnology offers the potential of novel and natural energy resources for Environmental sustainability that includes making of green nanoproducts in support of sustainability. Environmental sustainability is a responsible interaction with the environment to avoid depletion of natural resources and allow for long-term environmental quality. In nanotechnology, Carbon nanotubes (CNTs) have great attention because of their unique morphologies, which make their uses in wide variety of applications in environmental sustainability, medicine, biomaterials, energy production and electronics. Nanomedicines are used for the prevention and treatment of diseases in the human body for different purposes such as monitoring, repairing of cells, construction and control of biological systems on the level of molecules. Development of applications incorporating semiconductor nanoparticles to be used in the next generation of products, such as display technology, lighting, solar cells and biological imaging. Nanotechnological products, processes and applications are expected to contribute significantly to environmental and climate protection by saving raw materials, energy and water as well as by reducing greenhouse gases and hazardous wastes. Green Nanotechnology currently plays a rather subordinate role in environmental sustainability and security, whether it be in research or in practical applications like more efficient solar cells, solar thermal panels, practical fuel cells and environmentally friendly batteries.

Keywords: Green Nanotechnology, Environmental Sustainability, Natural Energy Resources, Energy Production.

INTEGRATED WEED MANAGEMENT IN TURMERIC UNDER MID HILL CONDITIONS OF HIMACHAL PRADESH

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Turmeric (*Curcuma longa* L.), an herbaceous plant belonging to family zingiberaceae, is one of the most valuable species cultivated all over the world. It is the ancient and sacred spice of India and is also known as “Indian Saffron” or “Golden Spice” or “Spice of Life”. This wonder spice contains various constituents like curcumin (1.8-5.4%), essential oil (2.5-7.2%), fat (5%), minerals (3.5%) and carbohydrates (69.4%). Curcumin, the principal component of turmeric rhizome, has immense medicinal properties as anti-inflammatory, anti-mutagenic, anti-carcinogenic, anti-tumour, anti-bacterial, anti-fungal, anti-oxidant, anti-parasitic and detoxifying agent. It is also used as a blood purifier and cures problems like indigestion and throat infection among others. Turmeric is a long duration crop and takes about 60 – 70 days for germination. This delayed emergence and slow initial growth makes this crop susceptible to weed infestation, which if not managed timely, can result in significant losses in productivity. Chemical weed management has become an integral part in crop production and use of herbicides is gaining popularity due to non-availability as well as increasing cost of labour. Keeping these points in mind a field experiment was conducted at the Research Farm of Department of Agronomy, CSKHPKV, Palampur during *kharif* season of 2017 to find an effective weed control strategy for this important crop. The trial had twelve treatments viz., metribuzin @ 0.70 kg/ha followed by (fb) hand weeding at 45 and 75 days after planting (DAP), metribuzin @ 0.70 kg/ha fb straw mulch @ 10 t/ha fb hand weeding at 75 DAP, pendimethalin @ 1.0 kg/ha fb hand weeding at 45 and 75 DAP, pendimethalin @ 1.0 kg/ha fb straw mulch @ 10 t/ha fb hand weeding at 75 DAP, atrazine @ 0.75 kg/ha fb hand weeding at 45 and 75 DAP, atrazine @ 0.75 kg/ha fb straw mulch @ 10 t/ha fb hand weeding at 75 days, oxyfluorfen @ 0.30 kg/ha fb hand weeding at 45 and 75 DAP, glyphosate @ 1.23 kg/ha fb hand weeding at 45 and 75 days, glyphosate @ 1.85 kg/ha fb hand weeding at 45 and 75 DAP, hand weeding thrice at 25, 45 and 75 DAP, weed control with organic practices (mulch fb hand weeding) and unweeded check, which were replicated thrice in randomized block design. Data was recorded on total weed count, total weed dry weight and weed control efficiency at periodic intervals along with fresh rhizome yield at harvest. The results so obtained revealed that the total weed count increased with the age of the crop with highest values recorded at 120 DAP after which the total weed count declined which may be due to increased intra and inter-competitive influences. Contrary to this maximum dry weight of weeds was recorded at 150 DAP which declined at later stage. All the weed control treatments significantly reduced the total weed count and dry weight of weeds as compared to the weedy check. Amongst different herbicide treatments application of metribuzin @ 0.7 kg/ha fb straw mulch fb hand weeding resulted in significantly lowest weed count at 120 DAP though this treatment was at par with application of this herbicide @ 0.7 kg/ha fb two hand weedings. These two treatments along with application of atrazine @ 1.0 kg/ha fb two hand weedings and atrazine @ 1.0 kg/ha fb straw mulch fb one hand weeding resulted in significantly lower dry matter of weeds as compared to other herbicide treatments which were at par with each other. Similar results were obtained for weed index calculated at 120 DAP with use of metribuzin @ 0.7 kg/ha and atrazine @ 1.0 kg/ha used along with straw mulch and one or two hand weedings proving effective as compared to other herbicides tested. The fresh rhizome yield was also significantly affected by different herbicide treatments with all herbicide treatments, except use of

oxyfluorfen @ 0.3 kg/ha fb two hand weedings, giving significantly higher yield while weedy check gave lowest fresh rhizome yield. From the present study it seems that mulching must be included in any effective weed management strategy for turmeric. Also among different herbicides metribuzin and atrazine are effective and their integration with mulching and/or hand weeding gave good control of weeds in turmeric.

Keywords: Turmeric, Integrated Weed Management, Herbicides

EFFECT OF DIFFERENT TEMPERATURE AND HIDROGEN-ION CONCENTRATION AGAINST CURVULARIALUNATA LEAF SPOT OF SPONGE GOURD

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Sponge gourd [*Luffacylendrica*(L.)Rox.] popularly known as in Hindi Ghiya, Tori, Nenua. It belongs to the family Cucurbitaceae. It rather difficult to assign which occuracy in indigenous area of *Luffa species*. The sponge gourd is native of India. *Luffaechinata* chromosome counts in the all species were found to be the same ($2n=26$) and comparative morphology of the wild and cultivated species and chromosome paiving in interspecific hybrid. It is one of the most common vegetable crops grown throughout the country in Brazil, Africa, and Indo Burma. The average cultivated are under this crop in India had been estimated to be 73273 ha. With production of about 685224 tons. Mitra (1921) first reported a new leaf spot disease caused by *Acrothecium penniseti* (*syn. Curvularialunata penniseti*) a parasitic species on Bajra over large area in North and Western India. The ginus *Curvularialunata* infected the leafy vegetable crop. It is a very ceviour disease problem in India. It is highly infection produce on cucurbitaceous crop like Sponge gourd, Pumpkin and Bottle gourd etc. Eight temperature viz. 10°C , 15°C , 20°C , 25°C , 30°C , 35°C , 38°C , and 45°C maintained in different incubators. Richard's medium was used as the basal medium and the average dry weight of the mycelium mat and degree of sporulation and final data were recorded after incubation of 10 days. Temperature was taken for ascertaining the optimum temperature and its range for growth of the fungus. Reported the optimum temperature for the growth of *Curvularialunata* was 25°C to 30°C . But the best growth was obtained at 30°C which significantly superior to the other temperature. Temperature is one of the most important physical factors affecting the metabolic activities of the fungi, among the environmental factor. The growth of fungus was also observed over a wide temperature range from 10°C to 45°C within optimum of 25°C followed by temperature 30°C and 25°C but least growth of the pathogen was observed at 45°C . Effect of hydrogen-ion concentration on vegetative and reproductive growth of the fungus Richard's medium was used as basal medium. Different initial pH meter and buffered by using N/10 sodium hydroxide and N/10 hydrochloric acid before autoclaving. Seven level of ph viz., 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, and 6.0 were used in the present studies. The fungus preferred for its best growth at the ph of the substratum around 5.0, although it grew over a wide range of pH from 3.0 – 6.0 ph.

DISTRIBUTIONAL PATTERN OF SHORT HORNED GRASSHOPPERS OF SUBFAMILY OXYINAE OF RICE FIELDS IN LARGEST STATE OF INDIA

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Short horned Grasshoppers belongs to order Orthoptera and suborder caelifera. Members of Genus *Oxya* are brown to greyish-green jumping insects bearing narrow, leathery front wings and thin, broadly triangular, transparent hind wings. These feeds broadly upon paddy leaves thus generally called rice grasshoppers in addition to grasses and weeds. Uttar Pradesh is the largest state of India in terms of Population and demarcated into Himalayan region, Gangetic plains and Vindhya hills. Majority of the population depends upon agriculture in the form of paddy and wheat. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one fifth of the calories consumed worldwide by the human. Paddy fields are a common sight throughout India, and cultivated twice a year in most parts of India known as Rabi and Kharif respectively. A survey was carried out between 2010 and 2012 in paddy ecosystem in largest state of India, Uttar Pradesh to explore the grasshopper species belonging to the sub family oxyinae. Grasshoppers collected through sweeping net and killed in jar bearing cyanide, then stretched and finally examined under stereo microscope. On the basis of observation it is found that five species, bearing three subspecies (*Gesonulapunctifrons*, *Oxyafuscovittata*, *Oxyavelox*, *Oxyahylahyla*, *Oxyahylaintricata*, *Oxya japonica japonica*) belonging to two genera (*Gesonula* and *Oxya*) are reported from paddy fields. During fully developed crop these starts feeding upon the leaves and leaving midrib, which results in decreasing of yield, thus acts as pest of paddy. To minimise the loss it is a basic need to find out these pests and its sustainable management to increase the yield.

Keywords: Distribution, Grasshoppers, *Oxya*, *Gesonula*, Uttar Pradesh

A REVIEW: INSIGHT INTO FUSARIUM WILT OF CHICKPEA IN THE CONTEXT OF MOLECULAR BASIS

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Fusarium wilt caused by *Fusarium oxysporum f. sp. ciceri*, is one of the major biotic stress in chickpea which may cause up to 90% yield loss in favorable conditions. Fungus intensely colonizes host roots causing complete blockage of water transport to aerial part in compatible host. India is the largest producer and accounting for over 65% of total world production (FAO, 2019). There are eight known races of fungus that are geographically distributed. Wilt management is primarily done by the use of wilt resistant cultivar and field sanitation practices. Along with breeders, molecular biologists are trying to understand the molecular basis at transcriptome, proteome, and metabolome levels. Transcriptome dissection revealed involvement of several transcripts that belong to various pathways found highly induced in metabolism, signaling, defense related transcripts, protein synthesis and degradation events, structural components, storage and transport related transcripts include MAP Kinase, respiratory burst oxidase, Manganese & copper superoxide dismutase, beta 1,3 glucanase, target of rapamycin, structural maintenance of chromosome 2 in incompatible interaction. LongSAGE transcriptome analysis has also highlighted several putative transcripts like

MAP kinase, 14-3-3 like protein, auxin binding protein, linoleate 9 S- lipooxygenase, cysteine protease, Delta protein. Protein studies identified similar pathways related proteins as indicated by transcriptome analysis. Majorly emphasized on metabolism related, ROS scavenging, protein synthesis and degradation related, defense related, signaling, storage, transport, structural proteins include PR protein, Trypsin protease inhibitors, ABA responsive protein (RAB18), cysteine protease, methyl esterases, 26 S proteasome subunits, protein disulphide isomerase, ripening related protein, profilins and albumins found to serve as important nodal factors for defense signaling network, NAC transcription factor. Metabolomic analysis has showed that flavonoid and isoflavonoid pathway and defense signaling metabolite are elevated during pathogenesis in resistant cultivar. Medicarpin and maickanin are found highly accumulated in incompatible host at the time of infection. Altogether these entire nodal molecules provide defense in an orchestrated manner during chickpea-Foc interaction in resistant cultivar. Functional characterization of these genes or molecular switches would earn better understanding and provide novel strategies to develop wilt-resistant varieties with valuable agronomic traits.

Keywords: Chickpea, *Fusarium oxysporum f. sp. ciceri*, Transcriptome, proteome, Fusarium wilt

INNOVATIVE APPROACHES IN INDIA FOR DOUBLING FARMERS INCOME THROUGH AGRICULTURE AND ALLIED ACTIVITIES

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Income is the most relevant measure to assess farmers' economic well being and sectoral transformation. The crises and distresses plaguing the sector endanger the very livelihoods and welfare of the farmers. Indian Government with the intention giving enough policy thrust on income security, proposed to double the farmers' income by 2022, platinum jubilee year of the Indian independence. The challenges faced by the farming community in the coming years have been highlighted for devising relevant pathway and strategies to enhance the income. Yield enhancement followed by cost reduction, fair price realisation and risk adaption has been identified as the potential pathway for doubling income. In the event of pursuing sustainable agriculture, food security, rural employment, and environmentally sustainable technologies are essential for holistic development. Indian agriculture and allied activities have witnessed a green revolution but in the years to come challenges to agriculture will continue to increase because large population is to be fed from declining land and water, in the scenario of climate change. It is well known that more than 58% of the rural households is dependent on agriculture, thus primary focus of the government has been on rural development to improve the livelihood of rural people. It is also evident that good rains can only help in the short run, but long term solutions are needed through water saving infrastructures and technologies. Some of the recent achievements have been possible due to spirit of our farmers, their hard work even in adverse conditions and in countable initiatives of the Government of India, like, National Food Security Mission, Rashtrya Krishi Vikash Yojna, Mission for Integrated Development of Horticulture as well as several research initiatives but the increase in production can only come from increase in productivity. Our productivity and income levels can be substantially increased by better use of technology and adoption of newer method. To achieve this target of doubling of farmers income by 2021-22, this Department has constituted a Committee under the Chairmanship of Additional Secretary (Policy) to examine issues relating to doubling of farmers' income by year 2021-22. The Government of India has taken appropriate measures to

increase farm income, stabilize production and, consequently, improve small farm productivity, Increasing availability of quality seeds and planting material for adoption of high yielding varieties and hybrids , Integrated Farming System, Water use technology for high efficiency. Branding of Indian food and agri produce for export promotion , Post harvest management for reducing post harvest losses (Food saved is food produced) , Covering risk through crop insurance will bring stability in farm income. Farmers' income can be improved when productivity goes up, cost of production comes down, if agricultural commodities produced get a remunerative price through a transparent price discovery mechanism.

Keywords: Farmers, Doubling income, Productivity

HEPAPROTECTIVE EFFICACY OF REDUCED GRAPHENE OXIDE-BETA CAROTENE (RGO- BC) NANOCOMPOSITE AGAINST EXPERIMENTAL HEPATIC FIBROSIS DISEASE MODEL

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Objective: In this study, albino rats were injected with N-nitrosodiethylamine (NDEA) to induce hepatic fibrosis and rGO- β C to observe possible effect.

Hypothesis: Composite of β -carotene with nanomaterials like reduced graphene oxide (rGO) may facilitate effective delivery of this carotenoid in the targeted organ.

Methods: *Abelmoschus esculentus* extract was used for the reduction of graphene oxide as a green reducing agent. The physical and chemical properties of the rGO and its composite with β -carotene were investigated using electron microscopy, EDX and FTIR spectroscopy. This composite was administered intraperitoneally to albino rats belonging to five different groups: Group-1: Control receiving normal saline, Group-2: rGO treated, Group-3: rGO- β C nanocomposite treated, Group-4: NDEA-treated and Group-5: NDEA + rGO- β C nanocomposite treated. Following sacrifice after two weeks, SOD, GST, catalase, liver function test enzymes and lipid peroxides were estimated. Alterations in the liver structure and collagen deposition were monitored by routine H&E, Picrosirius red stainings and electron microscopy (SEM and TEM).

Results: NDEA administration causes decline in antioxidant enzymes and significant elevation in liver function markers and lipid peroxidation. H&E, Picrosirius red and electron microscopy revealed deposition of collagen and alteration in hepatic architecture. However, rGO- β -carotene composite restores the deviated antioxidant status, possesses anti-fibrotic potential as revealed by histopathological and electron microscopic studies.

Implications: These results provide useful insight for facilitating the targeted delivery of β -carotene and its application in pharmaceutical products as an antifibrotic agent.

Keywords: Hepatic fibrosis, NDEA, rGO, β -Carotene

COMMUNITY STRUCTURE, REGENERATION STATUS AND SOIL PHYSICO-CHEMICAL PROPERTIES IN SAL FORESTS OF SHIVALIK FOOTHILLS, UTTARAKHAND, INDIA

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The present study was conducted in the foothills of Shivalik in Dehradun forest division to study the community structure, regeneration status and soil physico-chemical properties in Sal forests. For this study four sites were selected viz. Tilwari, Bhawala, Manudwala, Shuduwala. Total number of 12 sample plot (three in each site) of 0.1ha was laid randomly for the study purpose. The highest density was recorded in Manduwala site ($226.66 \text{ trees ha}^{-1}$) while lowest number of density was recorded in Tilwari site ($186.66 \text{ trees ha}^{-1}$). The highest population structure percentage of Sal (*S. robusta*) was recorded in 60 cm above diameter classes in all the sites and lowest was recorded in 10-20 cm diameter classes in all the sites. The maximum growing stock density of trees was recorded in Bhawala site ($398 \text{ m}^3\text{ha}^{-1}$) and minimum growing stock density of trees was recorded in Shuduwala site ($306.6 \text{ m}^3\text{ha}^{-1}$). Present study concluded that healthy growth of sal stand was observed in Bhawala site. In higher diameter classes, most advanced population was also observed in Bhawala site which indicates mature forest. Due to the presence of higher number of fully mature trees, Bhawala site was observed with maximum volume and growing stock as well as total carbon density. Soil physico-chemical properties indicated that soils were having good soil nutrients. The nutrient content decreased with increasing soil depths under all sites, whereas bulk density, particle density and pH increased with increasing soil depth.

Keywords: *S. robusta*, Community Structure, Regeneration, Uttarakhand

STUDY ON THE AMELIORATIVE EFFECTS OF EXOGENOUSLY APPLIED ALA ON GROWTH, PHOTOSYNTHESIS AND NITROGEN METABOLISM IN *Solanum lycopersicum* L. var. PUSA RUBY UNDER CADMIUM TOXICITY

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Heavy metal contamination in the environment is of serious global concern due to their bioaccumulation and bio-magnification ability in organisms. Cadmium contamination is of significant concern due to its high bioavailability, mobility and bioaccumulation in food chain. Cadmium is a potentially toxic heavy metal, alters the physiological and morphological parameters in the plant. Cadmium is of worldwide concern due to its carcinogenic activity. Cadmium induced impairment in redox homeostasis drives oxidative damage through generation of ROS. Ascorbate-glutathione cycle potentially quenches ROS by conjoint action of enzymatic or non-enzymatic action. Nitrogen is an essential macronutrient for plant growth and development, constituent of protein, nucleic acid chlorophyll etc. (Schible et al, 2004). Cadmium induces deleterious effect on nitrogen metabolism through modulation of NR activity, glutamate dehydrogenase and GOGAT activity (Chiraz et al. 2003). Alpha Lipoic Acid, a dithiol compound is cofactor of various enzyme complexes and has critical roles in energy metabolism. Positive effect of ALA on cell redox homeostasis, plant growth and seed germination on plant exposed to heavy metal support the usage of ALA in ameliorating heavy metal toxicity.

Tomato (*Solanum lycopersicum L.*) belongs to Solanaceae family is worldwide grown crop which is rich in lycopene, vitamins, mineral nutrient, tocopherol and polyphenol. Present experiment deal with following objectives:- (i) to assess the impact of cadmium toxicity on growth and biomass, photosynthetic pigment and carotenoids and nitrogen metabolism (ii) to determine Cd accumulation cadmium shoot, root by AAS. (iii) to study ameliorative effect of ALA on Cd induced toxicity. Implication of experiment is that ALA can be used as supplementation for improving crop productivity under heavy metal contamination.

INFLUENCE OF FLY ASH INCORPORATION ON SOIL PROPERTIES AND PRODUCTIVITY OF CROPS: REVIEW

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Fly ash (FA) is the byproduct of the coal combustion. There are several industries which depend upon coal as raw material for the production of electricity. The waste which is produce consists of major portion of FA. In today's scenario FA is one of the growing solid waste of the industrial sector which need a safe disposal due to its environmental constrains. FA plays a significant role in agriculture, because it has unique physical and chemical properties. It contains almost all the essential nutrients which are beneficial for plant growth and development. In the sector of agriculture, for buffering of the soil pH particular amendment is used which is known as fly ash. Fly ash is the residual component of thermal power plants and it remains stored in ash ponds where it leads to undesirable environment. In recent scenario the main objective is to make use of the fly ash in the agriculture sector and to find out its effect on the health of the soil. This investigation should be beneficial for various health organizations in mitigating the contamination which results from solid waste contamination.

Keywords: Crop growth, crop yield, fly ash, waste management and environment.

ROLE OF BIO-FORMULATION IN INTEGRATED MANAGEMENT OF FRUIT- ROT IN TOMATO UNDER TEMPERATE CONDITIONS OF KASHMIR

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A field trial was laid during Kharif 2019&20 at experimental field of the Division in a randomized block design. The 35 day old tomato seedlings cv. 'SH-1' were transplanted in a plot size of 2.0 x 1.5 m² at a plant spacing of 40 x 30 cm. The treatments comprised of different management practices [organic amendment (sheep manure)] @ 3 kg/m², cultural practices (stacking mulching by mustard pod straw @ 4 kg/m², removal of basal infected leaves); seedling treatments in bio-formulations 2 foliar sprays (mancozeb 75 WP @ 0.2%) 20 days after the onset of disease including an untreated checks. Each treatment was replicated 3 times. All the agronomical practices, except fungicidal sprays, were adopted as per recommended package practices. Minimum rotted fruits (1q/ha) was observed in spray treatments of 25% chemical (mancozeb 75WP@ 0.3% per liter of water) + 75% Talc bio - formulation at 1x10⁹ CFU and 50% chemical (mancozeb 75WP@ 0.3% per liter of water) + 50%Talc bio - formulation at 1x10⁶ CFU followed by removal of basal

leaves. A treatment with oil bio-formulation spray of crop and Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m + Sprays of mancozeb 75WP) was appeared to be most effective for both the diseases and minimum severity of fruit rot were recorded in buckeye rot (0.74%) and Alternaria rot (0.88%) resulting maximum healthy fruits. Talc based bio-formulation spray over the crop at fruiting stage followed by Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m + Sprays of mancozeb 75WP) was also exhibited to be most effective against fruit rot in tomato in buckeye rot and Alternaria rot resulting maximum healthy fruits (10q/ha). Most effective treatment of bio-formulation, Staking, Removal of basal leaves and mulching (mustard pod straw @ 4kg/m²) with sprays of mancozeb 75WP was found to be reduced the fruit rot incidences in tomato.

Keywords: Bio-formulation, Integrated management, fruit-rot, temperate, tomato

EPIDEMIOLOGY IN DEVELOPMENT OF ANTHRACNOSE DISEASE (*Colletotrichum lagenarium*) IN BOTTLE GOURD UNDER TEMPERATE CONDITIONS OF KASHMIR

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Bottle gourd (*Lagenaria siceraria*) crop was found to be severely infected with anthracnose disease caused by *Colletotrichum lagenarium* (Syn. *C. orbiculare*) in Kashmir with the cool and dew conditions under warm days. The incidence of the disease varied from 15 to 25% in different localities of Srinagar district, Kashmir, J&K. The characteristic symptoms appeared as circular, sunken, water-soaked lesions on vegetative parts of plants and fruits, later coalesced and covered larger areas. Results revealed that the severity of the disease increased with the increase in inoculum load and it was observed that spore concentration of 10⁶ spores/ml produced maximum disease severity (29.75%). Age of the leaves also played an important role in the development of the disease as disease severity increased in leaves up to the age of 40 days thereafter it declined. Leaf wetness for 24 hours provided maximum disease severity (48.70%), whereas leaf wetness beyond 24 hours had further no effect of severity. Further temperature (maximum) in the range of 28-32⁰c, temperature minimum 16-20⁰c, relative humidity (morning) 79-91 per cent and relative humidity (evening) 35.5-51.0 per cent were congenial for both spore production and disease development.

Keywords: Bottle gourd, Anthracnose, *Colletotrichum lagenarium*, Epidemiology, Temperate

COVID-19 PANDEMIC: IMPACT ASSESSMENT ON AGRICULTURE SECTOR AND THEIR MITIGATION MEASURES IN THE DISTRICT ALIGARH

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During COVID-19 pandemic, KVK, Aligarh disseminated latest technology with all support services amongst farmers for mitigation of present situation viz., advisory services, electronic/print/social media, ICT tools (Phone/Whatsapp/Facebook), live video conferencing, *Aarogya Setu*, *Kisan Rath*. The study was carried out in Aligarh district of Uttar Pradesh, which was selected purposively for the study. Out of 12 blocks two blocks namely Lodha and Atrauli were

selected purposively. The data were collected by interview schedule/questionnaire method with help of ICT tools like as live phone, whatsapp and others. Maximum effect was observed on marketing/food supply chain during the lockdown from COVID-19 for selling the vegetables and fruits (78%) due to low demand and difficulties in transportation, followed by mustard (16%) and wheat (7%). Availability of vegetables and fruits was ensured by frequent marketing, fresh and cheap products at doorstep was made available and due of that many rural people got engaged in the selling of vegetables and fruits who were unemployed before due to migration. 77% seed production farmers faced issues in purchasing packaging materials. Very much adverse effect was observed on fish/chicken/egg profession farmers. Farmers happily reported that his own health and his family health is better over the last year due to increase in health consciousness and by following the all instructions and advisories given by government and scientists of KVK Aligarh. Farmers are fully satisfied with *AarogyaSetu App*, *Kisan Rath App*, lockdown, government instructions, advisories and precautions circulated by KVK, Aligarh through ICT tools. Ration distribution was done successfully (97.00%) and money was transferred duly on time for MNREGA people (87.00%), respectively. Some farmers want more money as per need of family members. Salient recommendations have been suggested to help the farmers fight against the pandemic.

Keywords:Mitigation, Impact assessment, and ICT (Information and Communication Technology)

**EFFICACY OF BIOINOCULATNS AGAINST DISEASE COMPLEX
OFFusariumsolaniANDMeloidogyne incognitaON OKRA**

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Root-knot nematode, *Meloidogyne incognita* and root-rot fungus, *Fusarium solani* both individually as well as simultaneously cause significance loss in crop quality and productivity. However, simultaneous inoculation of both the pathogen causes huge loss. Chemical application for control of disease provides best result against managing the disease and improving productivity along with hazardous effect on human health by polluting the environment. The current scenario of research shifted towards management of plant diseases by eco-friendly means. Keeping in mind the economic and human health risk by chemical fungicides and nematicides an experiment was conducted to evaluate the extract of two bioinoculants, *Trichoderma viride* and *Trichoderma harzianum* in various combinations for management of disease complex of okra. Highest improvement in plant health, Plant length, fresh and dry shoot weight, number of pods and their weights, Chlorophyll content along with reduction in disease severity, number of root galls, root-rot index, nematode population was observed in the plant treated with both bioinoculatns simultaneously. However, plant treated with *T. harzianum* showed best result as compared to plant treated with *T. viride*.

Keywords:Bioinoculatns, *Trichoderma viride*, *Trichoderma harzianum*, *Meloidogyne incognita*

EFFECT OF ORGANIC AND INORGANIC FERTILIZERS, FLYASH ON PHYSICO-CHEMICAL PROPERTIES OF SOIL UNDER MAIZE CULTIVATION

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A field experiment was conducted to study the effect of recommended fertilizers, fly ash, vermicompost and farm yard manure (FYM), alone or in combination, on physical and electrochemical properties of soil under maize (*Zea mays L.*) cultivation during kharif season, 2017 in a Randomized Block Design (RBD) with three replications. The maximum available NPK, Ca&Mg,S in soil was recorded in treatment of T2 (100% RDF + 100% FYM) while, the minimum under T0 (control). It has been demonstrated that all combinations of nutrient sources exhibited significant positive impact over control with respect to available nitrogen, phosphorous, potassium, Calcium, magnesium and sulphur. However, the treatment including RDF +FYM (T2, 100% RDF + 100% FYM) performed best, followed by (T5, 40 % Fly ash + 60 % RDF + 60 % vermicompost). Present investigation revealed that application of organic manure along with chemical fertilizers and fly ash in different combinations helps in improving soil physical and electrochemical properties of soil.

Keywords: fly ash, vermicompost, farm yard manure, available nitrogen, phosphorous, potassium, Calcium, magnesium and sulphur.

EFFECT OF HARVESTING DATES ON THE YIELD AND QUALITY ATTRIBUTES OF THE WHEAT CULTIVARS

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Harvesting is the important parameter both for the researchers and the farmers. The harvesting of the crop should be done at the optimum time. The early, as well as the late harvest of the crop both, will lead to an irrecoverable loss in the yield of the crop. Many studies have been done on the harvesting of the wheat crop. It is the common practice in the case of wheat crop that the farmer will use the same seed again and again over the years, sometimes due non availability of resources the harvesting is delayed and to check the effect of harvesting dates an experiment was done in which the crop was harvested continuously for four days to find the effect of harvesting on the yield and its related attributes. Germination was less than the normal but was not having any significant difference. The germination percent of HD 3086 T₁(first harvesting) was 95.33% while T₄ (Fourth harvesting) was 94.33%, whilst PBW 343 T₁ (94.66%) and T₄ (93.33%). The dry weight was showing best result for both varieties at first harvest HD30886 T₁ (0.22) and PBW 343 T₁ (0.15) as compare to the fourth harvest T₄ (0.18) and PBW 343 T₄ (0.11) respectively. The similar trend was followed for vigour index the highest vigour was of first harvest and lowest for the fourth harvest HD30886 T₁ (20.89) and PBW 343 T₁ (14.12) as compare to the fourth harvest T₄ (17.34) and PBW 343 T₄ (10.60).

Keywords: Agriculture, Biotic, Crops, Density, Economic, Food

ACOUSTIC FREQUENCY RESPONSES IN PLANTS

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Sound is an acoustic energy in the form of a mechanical wave which transmits through gases, liquids and solids. Acoustic spectrum consists of three regions, infrasound (less than 20 Hz), audible region (20-20,000 Hz) and ultrasound (greater than 20,000 Hz). Infrasound and ultrasound are used in clinical diagnosis and therapeutics. Studies have revealed that audible sound stimulation has a great potential to improve plant growth and the quality of plant produce. Plant Acoustic Frequency Control Technology (PAFCT) is a new technique which uses acoustic frequency generator to produce appropriate acoustic waves that matches the frequency of the specific sound of plants. The effect of sound wave depends greatly on the intensity, frequency, exposure time and period of application. It can either enhance or restrict the growth of plants. The perception of audible sound by plants and their responses are not completely understood. The possible mechanisms proposed by scientists are enhancement of protoplasmic streaming, regulation of plasma-lemma H^+ ATPase activity and increased rate of transpiration caused by leaf canopy surface vibration. The mechanism of how acoustic frequency affects the cell cycle and growth of plants needs further research. Field experiments are needed to promote this technology for enhancing productivity of different crops.

Keywords: Acoustic Frequency, Sounds, Perception

RESPONSE OF RAINFED MUSTARD (*BRASSICA JUNCEA* L.) TO TILLAGE, SULPHUR AND BORON

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A field experiment was conducted during *rabi* season of 2016-17 and 2017-18 at research farm of Bihar Agricultural College, Sabour to assess the response of rainfed mustard (*Brassica juncea* L.) to tillage practices, doses of S and B. The experiment consisted of 27 treatment combinations having 03 tillage practices *viz.*, conventional tillage, zero tillage and reduced tillage, and 03 doses of S (0, 20 and 40 kg ha⁻¹) and 03 doses of B (0, 1.0 and 2.0 kg ha⁻¹) laid out in split split plot design replicated thrice. Results indicated that plant height and dry matter production per plant was observed highest with conventional tillage except LAI, which recorded maximum value with zero tillage and these parameters except LAI, increased with increasing S and B doses up to 40 kg ha⁻¹ and 1.0 kg ha⁻¹, respectively during both the years. Conventional tillage gave significantly higher seed yield over zero tillage during both the years. Highest seed yield (10.42 and 9.61 q ha⁻¹) was recorded with conventional tillage during 2016-17 and 2017-18, respectively. Significantly highest seed yield (10.65 and 9.85 q ha⁻¹) was recorded with 40 kg S ha⁻¹ over control and was at par with 20 kg S ha⁻¹ (10.45 and 9.51 q ha⁻¹) during 2016-17 and 2017-18, respectively. Significantly highest seed yield (10.59 and 9.75 q ha⁻¹) was recorded with 1.0 kg B ha⁻¹ over control and was at par with 2.0 kg B ha⁻¹ (10.40 and 9.44 q ha⁻¹) during 2016-17 and 2017-18, respectively. Interaction between tillage and sulphur was significant during both the years. Treatment combination of T₁S₃ was found the best in terms of highest seed yield (11.71 and 11.25 q ha⁻¹) during 2016-17 and 2017-18, respectively.

Keywords: Boron, Rainfed Mustard, Sulphur, Seed Yield, Tillage

BARRIERS IN ONLINE SHOPPING

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Online shopping is the process of buying goods and services from merchants who sell on internet. Shopper can visit web store from the comfort of their homes and shop as they sit in front of computer. Online shopping offers lots of tangible advantages to buyers. The whole concept of online shopping has altered in terms of consumer's purchasing or buying behavior. As every concept /ideas / technology does have advantages as well as limitation. Much of the research on online shopping has been concentrating on revealing out the advantages of concept in all possible dimensions without giving attention to the other side of the coin i.e. its limitation / barriers / constraints or even its disadvantages. Thus it is in this context, a study was conducted in the state capital of Odisha, Bhubaneswar with an objective to identify the barriers in online shopping.

Hypothesis- like advantages, online shopping does have few disadvantages from consumer's perspective also.

Methods- An exploratory as well as descriptive research design was followed by selecting 103 nos. of respondent consumers from banking as well as other financial institutions by following random sampling technique. Data were collected with the help of specifically developed pre-tested interview schedule by the researcher.

Results- The barriers of online shopping as identified through this study are in order of Risk in credit card transaction followed by lack of skill in using internet, low level of trustworthiness of online store, problems relating claim and warranty issue, nonperformance of the product as expected, risk of not getting what paid for, value added tax and finally slow in delivery of the product.

Utility- The findings of the study once known to the merchants, they will definitely make some strategic intervention to ensure full satisfaction of the customers out of online shopping.

Keywords: Online shopping, shop, buyer

CULTURAL, MORPHOLOGICAL AND PATHOGENIC VARIABILITY AMONG THE DIFFERENT ISOLATES OF *Fusarium oxysporum* f. sp. *cicero*

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Chickpea (*Cicer arietinum* L.) is an important pulse crop, which belongs to family *Leguminaceae*, chickpea having 2n=16 number of chromosomes. Chickpea is native of India and tropical, subtropical and temperate regions. It is ranked 3rd after common bean. Pulses play an important role not only from economical point of view but also due to their nutritional value. Chickpea is valued for their nutritive seeds with high protein content, 25.3-28.9 per cent after dehulling. Carbohydrate 61.5 per cent, fat 4.5 per cent and vitamins 2.44 per cent. Variability among the ten isolates of *Fusarium oxysporum* f. sp. *cicero*(FOC), collected from different locations of Parbhani district in Maharashtra. Ten isolates were studied in respect of cultural, morphological characters and Pathogenic variability.

Result of the above study reveals that pathogenic variability has been established by inoculating ten days old seedlings of different cultivars individually with the *Fusarium oxysporum* f. sp. *ciceri* isolates. JG 62 exhibited susceptible reactions to FOC isolates with highest percentage of seedling mortality whereas, JG 315 and BCP-160 were exhibited resistant reactions to the FOC isolates with lowest mortality percentage due to wilt varied within the cultivars. Cultural studies of all isolates of *F. oxysporum* f. sp. *ciceri* resulted that isolates differ in the growth rate, types of colony, sporulation, and pigmentation on Potato Dextrose Agar is being favorable for luxuriant growth for all the isolates and dry weight of mycelia mat growing them on Potato Dextrose Broth medium. Morphological studies of different isolates of *Fusarium oxysporum* f. sp. *ciceri* concluded resulted in the variations in size, septation and formation of chlamydospores.

Keywords : Chickpea (*Cicer arietinum* L.), *Fusarium oxysporum* f. sp. *ciceri* (FOC), isolates.

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON PHOSPHORUS CONTENT OF GRAIN AND STRAW OF RICE CROP VARIETY PANT DHAN

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A field experiment was carried out during Kharif season of 2010 and 2011 to study the effect of different nutrients treatments on the productivity of rice. This experiment reveals the fact that increased dose of Phosphorus also increase the amount of Phosphorus content in rice grain and straw. Phosphorus is needed by young tissues and it performs a number of functions related to growth, development and metabolism. Despite its ubiquitous importance to plant metabolism, phosphorus is one of the least available nutrients in many natural ecosystems. Total soil phosphorus is often hundred fold more than the fraction of inorganic phosphorus available for uptake by crop plants and most of the phosphorus applied to field form complexes with iron and aluminum in acidic and calcium in alkaline soil and thus becomes unavailable to plants. Low phosphorus availability strongly limits plant productivity in tropical soils. Although fertilizers are important for enhancing rice production but excess use of fertilizer cause deterioration of soil quality which ultimately affect crop productivity so it is required to investigate the physiological aspects of rice plant under integrated nutrients. When imbalanced fertilizers doses are given to the rice-wheat cropping system, they showed a considerable decline in crop productivity and soil fertility.

EFFECT OF DIFFERENT SOURCES OF NITROGEN LEVELS ON SOIL AND LEAF NUTRIENT CONTENT OF APRICOT

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Effect of different sources of nitrogen levels on chemical properties of soil and leaf nutrient composition of apricot cv. 'New Castle' was carried out at HR&TS, KVK, Kandaghat, Solan, Himachal Pradesh during the year 2017 and 2018. The experiment have been composed of eleven treatments i.e., T1:100% nitrogen (N) of recommended doses of fertilizers applied through calcium nitrate(CN), T2: 100% through urea, T3: 25% N (CN) + 75% N (urea), T4: 50% N (CN) + 50% N (urea), T5: 75% N (CN) + 25% N (urea), T6: 22.5% N (CN) + 67.5% N (urea) + 10% N (vermicompost), T7: 45% N (CN) + 45% N (Urea) + 10% N (vermicompost, T8: 67.5% N (CN) + 22.5% N (Urea) + 10% N (vermicompost), T9: 20% N (CN) + 60% N (Urea) + 20% N (vermicompost), T10: 40% N (CN) + 40% N (Urea) + 20% N (vermicompost, and T11: 60% N (CN) + 20% N (Urea) + 20% N (vermicompost). Application of different sources of nitrogenous fertilizers had shown significant changes in soil chemical properties and the nutrient compositions in leaf. Treatment second recorded the maximum soil nitrogen content and leaf nitrogen, manganese, iron, copper, and zinc with minimum soil pH. Significantly higher soil and leaf phosphorus along with potassium content were estimated in the treatment nine.

Keywords: Apricot, nitrogen levels, chemical properties, recommended doses of fertilizers

MITIGATION OF ABIOTIC STRESSES WITH NEW GENERATION PGRs IN FRUIT CROPS: A CURRENT PERSPECTIVE

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In the present world, abiotic factors act as a major limiting mean in influencing productivity and sustainability of fruit crops. Antagonistic cause due to drought, salinity, extreme temperatures, chemical toxicity and oxidative stress ensuing edapho-morphological and physio-chemical changes in fruit crops and also results environmental deterioration. Fruit crops confronting those abiotic stresses prepare to manage with the phytohormones as a self defense mechanism, which often notified as growth regulators. These PGRs have the potentiality to act over at cellular, tissue and organ levels. Among several PGRs, the new generation bioregulators found to have a tremendous scope in altering and regulating the nominal crop development and their response to environmental stimuli more specifically with commercial fruit crops. New generation PGRs *viz.*, auxins, brassinosteroids, polyamines and jasmonic acid found to be potent and action specific in alleviating the adverse effects of abiotic stresses in fruit crops by regulating crop metabolic processes and modulates the production of several osmolytes and secondary metabolites that supports in balancing plant-nutrients status in a nominal way. Among PGRs, abscisic acid confront the stresses owing to drought and salinity, while ethylene conserves crop from drought, flooding, salinity and cold. Jasmonic acid preserves crop from injuries due to drought and mechanical stress. Moreover, abiotic stresses rely on the crop genetic makeup of fruit crops, in which the PGRs render support by expressing resilience with mitigation.

Keywords :Fruit Crops, Abiotic stress, plant metabolic sign, PGRs, brassinosteroid, Jasmonic acid.

MATURITY INDICES OF *Piceasmithiana* CONES AT DIFFERENT ALTITUDINAL GRADIENTS IN NORTH KASHMIR INDIA

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For cone and seed maturation studies three altitudes were selected and cones were harvested fortnightly from August onwards till their maturation. Study revealed that prominent changes occur in cone and seed colour towards maturity. Cones mature in 1st fortnight of October at lower altitude (2,200-2,600 m) whereas at middle (2,600-3,000 m) and upper (3,000-3,400 m) altitudes cones mature in 2nd fortnight of October with chocolate brown colour at maturity. Maximum cone length and width was recorded at lower altitude 11.71 and 3.14 cm respectively and it decreased with increasing altitude. Cone weight showed a decreasing trend during successive collection dates as well as towards increasing altitude. Cone weight at maturity was 51.49 g at lower altitude and it decreased with increase in altitude. Seed viability increases as the cones proceed towards maturity and a maximum viability of 84.50 % was recorded at lower altitude (2,200-2,600) at maturity. Cone specific gravity, an index of maturity decreased towards maturity and ranged between 0.94 to 0.98 at different altitudes at maturity. Weight of seeds increased throughout the collection period and the maximum seed weight was recorded at lower altitude where it was 12.54 g/1,000 at maturity. The seed length and width also followed the same trend, and was maximum (6.01, and 2.24 mm) at maturity at lower altitude. The minimum moisture percent was recorded at maturity and it ranged between 17.47 to 26.21 per cent at different sites. Germination percent increased towards maturity and the maximum germination percent was recorded at lower altitude which was recorded as 34.87 %.

Keywords: *Piceasmithiana*, Cones, Maturation, germination, Weight.

GWAS FOR SPOT BLOTCH DISEASE IN WHEAT USING GAPIT WITH SUPER AND FarmCPU MODEL

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Wheat (*Triticum aestivum* L. emThell) is one of the most staple food crops. That is cultivated worldwide for the purpose to supply food for humans and feed to the animals. The objective of this study is to the genome-wide association analysis to dissect genomic regions in wheat germplasm harboring spot blotch disease resistance loci. A genome wide association study (GWAS) used an association mapping panel comprising 303 diverse genotypes in the form of spring wheat reference set (SWRS) of bread wheat procured from CIMMYT gene bank, Mexico. A set of 12,160 SNP genotypic data was subjected to this study and these SNPs were used for PCA/population structure analysis followed by GWAS analysis. A limited number of SNPs (42 SNPs considering one SNP from each arm of all chromosomes) was used for population structure analysis. Model-based cluster analysis of association mapping panel was conducted using the software STRUCTURE version 2.3.4. The number of sub-populations determined by ΔK method and comprised four subpopulations viz. G1, G2 G3 and G4. The four sub-populations included 31 (G1, red), 49 (G2, green), 50 (G3, blue) and 173 (G4; admixture, more than one color in a single block) genotypes,

respectively. Based on principal component analysis (PCA), first three principal components (PCs) explained 7.8%, 4.53%, and 3.19% variation within all 303 genotypes. GWAS results revealed that the total 77 MTAs were identified from BHU, Varanasi; out of which, 45 were identified by SUPER and 32 identified by FarmCPU, as well as 70 MTAs were identified from BISA farm, Pusa, Samastipur; out of which, 39 were identified by SUPER and 31 identified by FarmCPU. The above MTAs were selected at the significant level of $p \leq 0.001$ for all phenotypic traits viz., AUDPC, incubation period and lesion number. This study provides information about the genomic regions in SWRS panel that are associated with traits of agronomic importance and also spot blotch disease resistance.

Keywords: Wheat, Spot Blotch, GWAS

SOIL HEALTH CARD- AN INNOVATIVE APPROACH TO MAINTAIN THE SOIL HEALTH

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Soil is an important aspect and serves as a natural nutrient source for growth of plants. Healthy soil functions as a vital living ecosystem that sustains plants, animals and humans. There are various components of soil such as minerals, organic matter, water and air, which together form a system for plant growth. It is vital to manage and maintain the soil health for sustainable cultivation of crops. To ensure the overall health of the soil, maintain the balanced nutrients and prevent depletion of various components of soil, Government of India has introduced the Soil Health Card Scheme- an innovative approach that help the farmers about current status of fertility level of the soil. The scheme was launched on 19th of February 2015 at Suratgarh Rajasthan. The soil health card being a printed report is given to the farmers once in three years for his land holding and each farmer will get the chance of getting the soil sample tested, and after every three years, the soil from the farm will be tested again. The fertility level of the soil is tested on the basis of 12 separate parameters and contains tests of macro-nutrients, micro-nutrients, secondary nutrients and physical factors of the soil. Under the Scheme, each farmer is given the opportunity of getting important information about the fertility of their soil. This is done by collecting soil samples and tests are conducted in government or private laboratories. Thereafter the experts analyse the strength and weaknesses (micro-nutrients deficiency) of the soil and suggest measures to deal with it. The result and suggestions are displayed in the cards. Initially the government was planning to issue the cards to 14 crore Indian farmers. In cycle-I (2015-17) 110.74 crore of soil health cards were distributed to farmers and in Cycle-II (2017-19) 11.69 crore of cards have been distributed to farmers across the country. It was reported that 429 new Static Soil Testing Labs (STLs), 102 New Mobile STLs, 8752 Mini STLs have been provided and soil analysing capacity has been increased to 3.33 crore soil samples per annum in a short period of 5 years. So far 6954 villages have been identified by the state/ UT's, in which against the target of 26.83 lakh samples, 20.18 lakh samples have been collected, 14.65 lakh samples have been analysed and 13.54 lakh cards have been distributed to the

farmers. The SHC contains all basic and crop-wise recommendation of fertilizers or nutrients required for individual farms of different soil types, which help the farmers to improve productivity through judicious use of inputs. With the assistance of the Soil Health Card, the government is bound to provide an official report that assists in the evaluation of the fertility, nutrient composition, moisture level and other related aspects of the soil to the farmers. With the assistance of the results, the farmers are able to take necessary steps to improve the soil fertility. The scheme is implemented in all parts of the country. The scheme has been sponsored by the central government and the central is providing the state/UT governments an amount of Rs 190 for carrying out each soil sample test. A total of 568.54 crore was spent on over a span of 3 years. It has been estimated that during the implementation of the scheme, more than 14 crore of farmers will be benefitted, on a yearly basis. This target will be reached over a span of three consecutive years. 253 lakh samples have been evaluated in the labs every year.

Keywords: Card, Farmers, Health, Innovative, Soil,

DRAGONFRUIT: THE WONDEROUS EXOTIC FRUIT

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Dragonfruit (*Hylocereus* spp.) (Cactaceae), a herbaceous perennial cactus vine, also known as pitahaya, pitaya, pitaya roja, the strawberry pear, is native to Central Americas. The fruit skin has the bracts or scales hence known as the scaly fruit. This fruit is now grown all over the world in tropical and sub-tropical countries and introduced in India during the late 90's. In India, the cultivation of this fruit has taken up in Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Orissa, West Bengal, Andhra Pradesh, and Andaman & Nicobar Islands. The total all India dragon fruit cultivation may be less than 400 ha. The awareness and demand for the fruit are tremendous in India mainly for its therapeutic, antioxidant, and nutraceutical properties. This fruit helps to restrain chronic illness, allergic reactions, improve the health of the alimentary canal, boosting the body's immunity. Dragonfruit is the wonderful fruit of the 21st century commenced to ring in a revolution to the Indian Horticulture scenario. There are a limited number of commercial producers in the country and the fruit demand is very high. The 95 percent of the requirement is satisfied by importing fruit from Thailand, Malaysia, Vietnam, and Sri Lanka. As the demand for dragonfruit is more in the country, it created an opportunity for the farmers to grow dragon fruit commercially on a large scale. The country must need to increase the area under its cultivation, this provides farmers better opportunities in terms of business ventures, research, development, and extension collaborations.

Keywords: Dragonfruit, Cactus vine, Pitahaya

SOIL EROSION AND ITS CONTROL FOR MAINTAINING SOIL HEALTH

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Soil is the most precious gift of nature, an excellent resource of food, fodder, and the home for billions of microbes. Soil erosion is the detachment, transport, and deposition of soil particles on the land surface and is also termed as a soil loss. Soil loss is of concern primarily on-site effect (loss of crop productivity) and off-site effect (siltation in ditches, streams, reservoirs and, sediment generated). Soil erosion deteriorates soil quality and diminishes the productivity of the natural, agricultural, and forest ecosystems. There are some natural (rain, wind, water, deforestation, slope, nature of the rock) and man-made factors (monocropping, deforestation, shifting cultivation, overgrazing, barren grounds) that affect the soil erosion. The soil erosion intensity is mainly affected by climate, topography, soil type, and vegetation. The numerous methods like strip cropping, cover cropping, mulching, vegetation, contour farming, afforestation, retaining walls, windbreaks, conservation ditches, trenches, pits, check-dams, Silvi-Pastoral, Horti-Pastoral, Agri-Silvi systems, and Agri-Horti systems, etc. can be used to manage soil erosion. The rainwater harvesting and conservation for the future helps to increase the groundwater level.

Keywords: Soil, Erosion, Soil Health

SUPPLY CHAIN HINDERANCE OF MEAT AND POULTRY INDUSTRIES DUE TO COVID 19

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Lockdown which was imposed due to Covid 19 pandemic has disturbed supply chain and distribution of the food. A bottleneck system could be observed. Moreover, it has disturbed the harvest due to unavailability of machineries and laborers. APMC markets are closed, which was the one of the most important market where the farmers sell their produces. Due to supply and demand gap huge fluctuation of market prices in the food commodities. We could see the increase in the prices of edible oil due to slowing of industrial activities It has also lead to increase in prices other essential agricultural products such as pulses, vegetables etc. It has mainly affected the meat and poultry industries adversely. During the initial stage of the lockdown there was a huge decline in the sale of poultry eggs too due to hoax of spreading covid. Later we could see 100% increase in mutton prices and 50% increase in chicken prices in the major consuming cities like Hyderabad, Bangalore and Chennai. It is slightly lesser in major meat consuming town. This paper concentrates on the bottleneck system in the meat and poultry industries and also suggest a necessary measures and models to improve it.

Keywords: Agri-business; price fluctuation; value chain

INLAND FISHERIES; SCOPE OF INCOME FOR THE COASTAL FARMERS

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Farmers who are located in the coastal areas are specialized in fishing and they are also involved in agriculture for meeting their livelihood. This paper talks about environmental conservation without making the socio-economics condition of the coastal farmers worse off. There are many varieties of sea animals which are the rich source of food for a human being has been diminishing over years. Inland fisheries, which are another word for fish rearing in ponds and lakes, could be a scope for the coastal farmers to enhance their income by using their specialization. The sea fishes and other animals which are diminishing could be preserved if the coastal farmers could involve in fish rearing rather going for fishing. Scientists have also discovered and optimized the variables for breeding fishes so that the offspring production could be maximized to a large extent. The knowledge could be used for diversification. Inland fish rearing could be also practiced not only by the farmers who are specialized in fishing but also by other coastal farmers who are specialized in agriculture and holding a farm in a coastal area. The farmers could go for these “alternative livelihood” activities which will lead them to enhance their income through diversification. Fish farming could be done in monoculture i.e. single variety fish rearing and polyculture i.e. multiple variety fish rearing, by considering the factors such as the availability of natural feed for the fishes, availability of the fish varieties, environment etc. The famous varieties of fish in India which could be reared inland Catla, Rohu, Mrigal, Silver carp, grass carp, common carp. These all varieties are very friendly and don't feed on each other. Hence, it could be reared together. These varieties feed on vegetable leaves, animal biota, plant material, decomposed materials, organic matters, aquatic insects, grass etc. these varieties of seeds could be simultaneously left in the pond from the month of June to September. In an acre of land could fetch around 2100-2250 kg yield if proper nutrition is provided. The fish pond should be sloppy and in low lying areas with availability of tank water and drainage facility. The base of the pond should be such type of soil which could stagnate the water. Generally, red and clay soil is considered to be the best to form the base of the fish pond and it is very fertile too. The shape of the pond could be rectangular and from should spread in an area at least of 0.25 acre to hector for an economic yield. The depth of the water should be 4-5 feet and tank bunds should be 0.5 meters above the water level. Water management should be done regularly for a better growth of the fishes. The farmer should maintain 7.8to 8.5 ph. Range, water transparency 25-30 cm, and light greenish in color. The farmer should stop artificial feeds and fertilizer if the water turns more greenish. Therefore, coastal area could be the ideal place for it.

Keywords: Ecology; aquaculture; Pisciculture; sustainable development welfare economics

PHYSICO-CHEMICAL ANALYSIS OF HONEY AND POLLEN COLLECTED FROM VARIOUS LOCATIONS OF UTTARAKHAND AND UTTAR PRADESH

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Honeybees (Class: Insecta, Order: Hymenoptera, Family: Apidae, Subfamily: Apinae, Tribe: Apini, Genus: Apis) are eusocial insect entirely dependent on floral resources like nectar and pollen. Honey is one of the few virtually non-allergic foods that body easily assimilates Rahman et al. (2010), it is a high-energy carbohydrate food (80–85%) which is easily digestible as many fruits. The physico chemical composition of 10 honey samples collected from various locations of Uttarakhand and Uttar Pradesh were analysed at Pantnagar. Different honey samples had a significant difference in these properties. The moisture content of honey sample ranged from 12.96 - 19.02 %, pH 3.28 - 4.80, acidity 0.12 % - 0.60 %, total soluble solid 68.2 – 71.00 brix, Total solid 80.97 - 87.03 %. The pollen found to have Nitrogen per cent and crude protein ranged from 3.04 – 4.14 % and 19.01 – 25.87 % respectively. Haldwani sample was found better in context of lower moisture content 12.96 % and total solid 87.03 %. Pilibhit honey sample contained high acidity per cent 0.60 % and Dineshpur honey sample showed high TSS (Total soluble solid) 71.00 brix. Highest nitrogen 4.14 % and per cent crude protein 25.87 % found in Haldwani pollen sample.

GBS BASED GWAS TO EXPEDITE MARKER-THEBAINE ASSOCIATION

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Opium Poppy (*Papaver somniferum* L.) has been widely used since ancient period due to its immense medicinal values. The latex of the opium poppy is known as opium that contains several pharmaceutical important alkaloids such as morphine, codeine, thebaine, narcotine and papaverine. Despite the over increasing demand of thebaine, no studies have particularly focused to unravel the underlying genomics for high thebaine production except few studies on thebaine pathways. However, our group has first time developed the stable high thebaine opium poppy breeding lines through inter-specific cross followed by eight successive generations of selective breeding strategy. This above background of opium poppy offers the ample of scope to understand how and why the opium poppy becomes thebaine rich. Thus, we have hypothesized that the underlying reason behind such drastic deviation could be associated with variation in the genome scale. Therefore, the present study aims to combine the approaches like GBS and GWAS to identify the potential SNP markers associated with such variations with or without the reference genome for assembling sequencing data. Our results suggest that, a total of 1.5GB/ sample to 0.8GB/sample data was obtained in GBS analysis by using individuals from 60 core germplasms. Besides, a total no of 8,750 SNPs were identified through GWAS analysis. Such studies would be helpful in developing improved poppy varieties through MAS programme and therefore could significantly contribute for the betterment of such agronomic traits.

Keywords: Thebaine, Opium poppy, alkaloid, GBS, GWAS, SNP

EFFECT OF FYM, BIOFERTILIZERS AND INORGANICS ON GRAIN YIELD AND YIELD ATTRIBUTES OF BLACKGRAM UNDER INTEGRATED NUTRIENT MANAGEMENT (*Vigna mungo* L.)

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A field experiment was conducted at Advance Centre for Rainfed Agriculture at RakhDhiansar, SKUAST-Jammu, during two consecutive years 2016 and 2017 to study the effect of integrated nutrient management on grain yield and yield attributing characters of blackgram variety-Uttara. The treatments consisted different combinations of inorganics and organics including bio fertilizers *Rhizobium* and phosphorus solubilizing bacteria. It was observed from the results that application of P40 + 0.5Mo + PSB + *Rhizobium* + FYM (T₁₃) produced maximum number of nodules per plant (13.15, 13.81), number of pods per plant (20.45, 23.60) and number of grains per pod (8.08, 8.94) during both the years. Further, the grain yield (1291, 1388 kg ha⁻¹) and straw yield (2334, 2423 kg ha⁻¹) of blackgram reflected higher under treatment received P40 + 0.5Mo + PSB + *Rhizobium* + FYM (T₁₃) during 2016 and 2017.

Keywords: Blackgram, INM, FYM, Yield and Biofertilizer

PERFORMANCE OF INTERCROPS IN SUGARCANE (PLANT CANE) BASED INTERCROPPING SYSTEM

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A field experiment was conducted during 2016-17 (plant cane) at Sugarcane Research Farm, Zadshapur of S. Nijalingappa Sugar Institute (SNSI) of Belagavi. The experiment was laid out in split plot design with three spacing levels (120, 150 and 180 cm) as main plot treatments, three component crops (sugarbeet, sweet sorghum and sweet potato) under 1:1 and 1:2 ratio as sub-plots with four control plots [sole sugarcane (90 cm), sole sugarbeet, sole sweet sorghum and sole sweet potato] outside the experiment and replicated thrice. Sugarcane (150 cm) + sugarbeet 1:2 row proportion recorded significantly higher tuber yield (8.4 t ha⁻¹) and ethanol yield (689 l ha⁻¹). Sugarcane (210 cm) + sugarbeet 1:1 row proportion recorded significantly higher tuber weight per plant (188.2 g plant⁻¹). Sugarcane (210 cm) + sugarbeet 1:1 row proportion recorded significantly higher tuber diameter (10.4 cm). Sugarcane (210 cm) + sugarbeet 1:1 row proportion recorded significantly higher total dry matter production per plant at harvest (75.28 g plant⁻¹). Sugarcane (150 cm) + sweet sorghum 1:2 row proportion recorded significantly higher green stalk yield (16.1 t ha⁻¹) and higher ethanol yield (360 l ha⁻¹) in sweet sorghum. Sugarcane (150 cm) + sweet potato 1:2 row proportion recorded significantly higher tuber yield (8.7 t ha⁻¹) and ethanol yield (701 l ha⁻¹) in sweet potato. Sugarcane (210 cm) + sweet potato 1:1 row proportion recorded significantly higher tuber yield per plant (132.65 g plant⁻¹) and found at par sugarcane (210 cm) + sweet potato 1:2 row proportion (129.50 g plant⁻¹). Sugarcane (150 cm) + sugarbeet 1:2 row proportion recorded significantly higher sugarcane equivalent yield (145.7 t ha⁻¹) and ethanol yield (9.50 thousand l ha⁻¹).

Keywords: Sugarcane, Sugarbeet, Sweet sorghum and Sweet potato

PERFORMANCE OF COMPONENT CROPS IN SUGARCANE (RATOON CANE) BASED INTERCROPPING SYSTEM

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A field experiment was conducted during 2016-17 (plant cane) at Sugarcane Research Farm, Zadshapur of S. Nijalingappa Sugar Institute (SNSI) of Belagavi. The experiment was laid out in split plot design with three spacing levels (120,150 and 180 cm) as main plot treatments, three component crops (sugarbeet, sweet sorghum and sweet potato) under 1:1 and 1:2 ratio as sub-plots with four control plots [sole sugarcane (90 cm), sole sugarbeet, sole sweet sorghum and sole sweet potato] outside the experiment and replicated thrice. Sugarcane (150 cm) + sugarbeet 1:2 row proportion recorded significantly higher tuber yield (7.2 t ha⁻¹) and ethanol yield (617 l ha⁻¹) in sugarbeet. Significantly higher tuber weight per plant was recorded by sugarcane (210 cm row spacing) + sugarbeet 1:1 row proportion (168.50 g plant⁻¹). Sugarcane (210 cm) + sugarbeet 1:1 row proportion recorded significantly higher tuber diameter (10.4 cm). Significantly higher nitrogen uptake (21.17 kg ha⁻¹) and potassium uptake (19.79 kg ha⁻¹) was recorded by sugarcane (150 cm) + sugarbeet 1:2 row proportion. Significantly higher total dry matter production per plant was recorded by sugarcane (210 cm) + sugarbeet 1:1 row proportion (69.0 g plant⁻¹). Maximum green stalk yield (15.7 t ha⁻¹) and ethanol yield (311 l ha⁻¹) was recorded by sugarcane (150 cm) + sweet sorghum 1:2 row proportion at harvest. Significantly higher total dry matter production per plant (85.67 g plant⁻¹) was recorded by sugarcane (210 cm) + sweet sorghum 1:1 row proportion. Significantly higher tuber yield (7.90 t ha⁻¹) was recorded by sugarcane (150 cm) + sweet potato 1:2 row proportion. Significantly higher tuber weight per plant was recorded by sugarcane (210 cm) + sweet potato 1:1 row proportion (127.90 g plant⁻¹) and found on par with sugarcane (210 cm) + sweet potato 1:2 row proportion (124.60 g plant⁻¹). Significantly higher tuber volume (334 cm³) was recorded by sugarcane (210 cm) + sweet potato 1:1 row proportion. Significantly higher total dry matter production per plant (95.78 g plant⁻¹) was recorded by sugarcane (210 cm) + sweet potato 1:1 row proportion. Sugarcane (150 cm) + sugarbeet 1:2 row proportion recorded significantly higher sugarcane equivalent yield (121.6 t ha⁻¹) and significantly higher system ethanol yield.

Keywords: Sugarbeet, Sweet sorghum, Sweet potato and ethanol yield

ENHANCING ENVIRONMENTAL SUSTAINABILITY BY IMPLICATIONS OF MICROBIAL CONSORTIUM IN RICE STRAW MANAGEMENT: A REVIEW

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Rice is the main staple food in most of the countries which generate huge amount of rice straw as crop residues. Open burning of crop in the field not only produces threat to environment by producing large amount of greenhouse gas (GHG) emission, but also make farmer's loose a very viable by-product. Straw can be used as fuel for cooking, ruminant fodder, and stable bedding or as a raw material in industrial processes. Rice straw can be used in bio-ethanol production and bring additional income and sustainable utilization. The pre-treatments include physical, Chemical and biological treatment such as enzyme or microbial conversion. Microbial enzymes play role in natural biodegradation process in which plant lignocellulosic materials are efficiently degraded by

fungi and bacteria. Microbes like *Trichoderma reesei*, *Trichoderma viride*, *Penicillium pinophilum*, *Phanerochaete chrysosporium*, *Fusarium solani*, *Talaromyces emersonii*, *Trichoderma koningii*, *Aspergillus niger* and *Rhizopus oryzae* are found to individually or in consortium are capable for solubilisation of lignocellulosic biomass. The optimum co-culture condition was 14% (w/v) of the inoculum concentration, the equivalent inoculation of the microbes, 30 °C of the culture temperature, and 1:1.4 of the solid-liquid ratio. Test like filter paper enzyme activity (FPA) and CMC enzyme activity (CMCase) were used to indicate the cellulase activity and also DRL (Degradation rate of Lignin) and DRC (Degradation rate of cellulose) were calculated. The biodegradation of lignocellulosic was confirmed by FTIR, HPLC and SEM analysis. Consortium of microbes increases the degrading rate, under the optimized conditions and provides information for the efficient utilization of rice straw to produce more accessible energy resources, such as ethanol and glucose.

Keywords: Rice straw, Lignocellulosic biomass, Consortium, FTIR, SEM.

STUDIES ON SUSCEPTIBILITY OF BDR-10 AND DBV TO DIFFERENT PATHOGENS: INDICATING RESISTANCE BEHAVIOR IN BDR-10 AGAINST THE VIRUS

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Tropical tasar silkworm, *Antheraea mylitta* is wild silk-producing fauna in India. The silk derived from this silkworm is popularly known as Kosa Silk. The DABA Bivoltine (DBV) and Trivoltine (DTV) are commercially available races across India. Recently, a new race *i.e.* BRD-10 was developed through the selection of yellow larval type and authorized for commercial rearing. The yield parameter of BDR-10 was quite substantially promising compared to DBV in several places. To unravel the reason, a comparative field study was conducted to know the susceptibility of both DBV and BDR-10 for various disease. The overall mortality of silkworm due to different diseases was significantly less in the BDR-10 compared to DBV ($t=1.79$; $df=9$; $P=0.05$). The DBV race found succumbed to viral infection at all stages (instar). But, bacterial and fungal infection were recorded during and subsequent stages after third and fourth instar, respectively. BDR-10 larvae were susceptible to viral infection from third instar onwards. But, bacterial and fungal infections were recorded during and subsequent stages after the second and fourth instar, respectively. Calcium excretion symptom is a new type of disease of bacterial infection was recorded on fifth instar larvae of both DBV and BDR-10 races. A comparative study on mortality of larvae due to different infectious pathogens on fifth instar silkworm of both races revealed that the viral infection was significantly less in BDR-10 race compared to DBV ($t=3.19$; $df=9$; $P=0.005$). There was no significant differences in mortality between BDR-10 and DBV due to bacteria, fungus and calcium excretion symptoms ($P>0.05$). Cocoon yield was significantly more in the BDR-10 during 1st and 2nd crop compared to DBV (1st crop: $t=1.95$, $df=15$; $P=0.03$ and 2nd crop: $t=1.84$, $df=15$; $P=0.04$). Our results suggest BDR-10 moderately resistance to viral infection compared to DBV.

Keywords: Tasar silkworm, Kosa Silk, Cocoon.

DIVERSITY AND PHYLOGENETIC RELATIONSHIP OF ENTOMOPATHOGENIC NEMATODES FROM BLACK PEPPER (*Piper nigrum* L.) MAJOR GROWING AREA OF INDIA

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Survey and 76 soil samples were collected from black pepper rhizosphere from different locations of districts Kozhikode and Wayanad of Kerala and Kodagu district of Karnataka, India. Entomopathogenic nematodes (EPNs) were isolated from the soil by insect baiting technique and characterize the positive soil samples like soil type and pH. DNA extracted from the EPNs and amplified by using primers 18S (FORWARD) 5' TTGATTACGTCCTGCCCTTT 3' and 26S (REVERSE) 5' TTCACTCGCCG TTAATAAGG 3'. The sequencing was done using purified PCR product. The phylogenetic analysis was inferred using the Neighbor-Joining method. About 5.26 % EPNs were recovered from the soil. Among the isolated EPNs, three each EPNs were found from Kozhikode and one from Wayanad districts. Among the positive samples, maximum EPNs were recovered from laterite soil (50%), followed by alluvial (25%) and sandy soil (25%). For pH, isolated EPNs from 4.4 to 5.7. Among the four isolates, one belonged to genus *Heterorhabditis* sp. (IISR-EPN 10); one to *Steinernema* sp. (IISR-EPN 11) and two to *Oscheiusspp.* (IISR-EPN 12 and 13). This is the first report of EPNs from black pepper rhizosphere. These indigenous EPNs will be suitable for managing the local insect pests of black pepper because of their adaptation to local climate and population regulators. Further studies are required to know the exact behaviour, pathogenicity, mode of action and multiplication. These EPNs open the prospect for using them in biological control programs against insect pests of black pepper.

Keywords: Entomopathogenic nematode, Black pepper, diversity

INVITRO MANAGEMENT OF *Alternaria porri* CAUSING PURPLE BLOTCH DISEASE OF RABI ONION THROUGH PLANT EXTRACTS, BIO AGENTS AND CHEMICALS UNDER ODISHA CONDITION- A REVIEW

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Among the diseases, Purple blotch disease is an important foliar disease which is incited by a fungus *Alternaria porri* causing huge economic loss in Rabi onion in India including Odisha. Reviews indicated that the extracts of *Adhatodavasica* at 5% and 10% concentration causes significantly maximum inhibition of mycelial growth (91.11% and 95.55%) of *A. porri*. Also the 10% concentration of extracts of *Allium sativum* and *Aloe vera* shows the maximum inhibition of growth (58.05% and 53.5 %) of *Alternaria porri* respectively. With the bio control agent maximum inhibition of colony growth of *Alternaria porri* was observed by *Trichoderma viride* which was statistically significant over all other bio agents tested. Probable mechanism could be the higher competitive ability, stimulation and antibiosis by *Trichoderma* isolate over test pathogen. With the chemicals complete inhibition of the Mycelial growth of *Alternaria porri* was observed due to all the three concentration of Bavistin DF and Companion (0.1gm/100 ml, 0.2gm/100 ml, 0.3 gm/ 100 ml) followed by 90.49% inhibition was found by Copper oxychloride. Among the bio agents, *Trichoderma viridae* was found as more effective in inhibiting the Mycelial growth of *Alternaria*

porri. On the other hand phyto extracts of *Adhatodavasicash* showed maximum growth inhibition among the plant extracts. Hence suitable integration of more efficient, eco friendly treatments like bio agents and botanical may provide better management of the purple blotch disease of Rabi onion in which onion used as human consumption. However fungicides also showed excellent efficacy against purple blotch disease, limited use of fungicide for seed production could be used to prevent greater yield losses of the crop.

Keywords: Purple blotch, Rabi onion, Phytoextracts, Bio agents, Chemical control, Odisha.

COMPARATIVE PHYSIO CHEMICAL PROPERTIES ANALYSIS OF UNRIPE AND RIPE PUMPKIN (*Cucurbita moschata* L.)

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The present investigation entitled “Comparative qualitative analysis of unripe and ripe pumpkin (*Cucurbita moschata* L.)” was carried out in department of agriculture, Mata Gujri College, Fatehgarh Sahib, Punjab, India. The experimental design selected was CRD consisting of pumpkin variety as fruit and seed are treatments which were replicated four times. A good quality fresh and healthy pumpkin variety, the Punjab samrat was collected from the Experimental Field of Mata Gujri College, Fatehgarh Sahib. The healthy disease free, unripe and ripe fruits were selected and washed with water in order to remove dust, dirt and any other foreign material. The highest Carotenoids in peel (0.961mg/100gm), Pectin content in peel (1.01%), fat content in seeds (36.46%), Energy in seeds (522.47Kcal/100gm), Na (2.79mg/100gm), K (329.52mg/100gm), Ca (44.22mg/100gm), Mg (18.24mg/100gm), Fe (μ g/100gm), Mn (μ g/100gm), Cu (μ g/100gm), Zn (μ g/100gm) and Se (μ g/100gm) in fruit and Na (6.95mg/100gm), K (809.21mg/100gm), Ca (45.35mg/100gm), Mg (591.12mg/100gm), Fe (8.87mg/100gm), Mn (4.44mg/100gm), Cu (1.31mg/100gm), Zn (7.72mg/100gm) and Se (9.30 μ g/100gm) in seeds was reported highest at ripe stage of pumpkin. The antioxidant potential of peel in the form of Phenol (14.145mg/100gm), Tannin (0.57mg/100gm), was reported maximum at ripe stage of pumpkin. There were distinct variations among the two different stages of pumpkin for nutritional and physico-chemical characters of fruit under study and it can be concluded that the ripe stage of pumpkin was superior to unripe stage in most of characteristics.

Keywords: pumpkin (*Cucurbita moschata*), physico-chemical, peel, pulp, seed, unripe, ripe

KNOWLEDGE LEVEL AND UTILIZATION OF UZHAVAN APP AMONG THE FARM YOUTH IN THANJAVUR DISTRICT OF TAMIL NADU

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Agriculture is the backbone of the Indian economy. Agriculture provides most of the raw materials for the industries and also provides wage goods required by non-agriculture sectors. Over the years, agricultural extension has been at the fore-front in the delivery of adequate information to farmers for increased productivity. Information and knowledge are very vital in agricultural development of any community and where they are poorly disseminated the community is at risk of development. Farm youth are the precious asset which have an important role in developmental agricultural

activities. If the talents and abilities of them are properly guided and nurtured, agriculture will attain sustainable growth. Hence, the present study was taken up to assess the knowledge level and Utilization of Uzhavan App among the Farm Youth. The study was taken up in Thanjavur district of Tamil Nadu. Sample size of 120 farm youths was selected by using snowball sampling technique. Data were collected with the help of a well-structured and pre tested interview schedule. The data collected were scored, tabulated and analysed using the statistical tools viz., cumulative frequency, percentage analysis. The result indicates that 48.91 as the overall mean percentage of knowledge on uzhavan application. that unavailability of internet was the major constraint expressed by majority of the respondent (85.00 per cent), followed by unable to explore internet (80.33 per cent), lack of awareness (74.17 per cent) and non- availability of mobile phone (65.83 per cent).

Keywords: Knowledge Level, Utilization, ICT Tool, Uzhavan App, Farm Youth

ORGANIC FARMING FOR SUSTAINABLE CROP PRODUCTION

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Organic farming is centuries old human and natural intervention which has been eco-friendly and economically viable. It comprises eco-friendly agricultural techniques leading towards the maximum production without using chemical inputs. Nature friendly farming approach helps in reducing the negative effects of environmental pollution by recycling crop rotation, using crop debris, farm yard manure, pest control with biological methods, appropriate tillage, cultivating legumes to add organic matter in the soil and to mitigate the climate hazards. A majority of rural population in India is willing to adapt the organic farming practices to save their input costs for better livelihoods. The farm-home women are playing a great role in agricultural development and livestock management. Organic farming is efficient for eco-system providing a balance in the life of human, crops and animals; hence leading to the sustainability of the system. India is one of the agricultural based Nations with more than two third of the population is directly or indirectly involved in agricultural sector. Before 1960, in India only traditional agriculture was followed without intervention of synthetic and chemical fertilizers and pesticides. There was threatening to food security to fulfil the hunger of the population and frequent climatic aberrations during late 1960s. The Government of India had entered into the path of so called green Revolution. There was increase in production and productivity at that time and our country was able to satisfy partly the food security. During the last two decades, there has been a significant sensitization of the global community towards environmental preservation and assuring of food quality. The promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almost a century of development, organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people. In this article, study is done about present status, scope and future potential of organic farming in India in global perspective.

Keywords: Agricultural development, Food security, Future prospects, Sustainability, Organic farming

GENETIC DIVERSITY STUDIES FOR YIELD AND YIELD CONTRIBUTING TRAITS IN LINSEED (*Linum usitatissimum* L.)

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Sixty nine genotypes were evaluated for genetic divergence to identify potential parents for linseed programme aimed for yield improvement in rabi 2018-19. Mahalanobis D^2 statistics for fourteen characters were used in this study for computing genetic divergence. The analysis of dispersion for thirteen characters correlated variables using Wilk's criterion, revealed highly significant difference between genotypes for all thirteen characters. The sixty nine genotypes were grouped into ten clusters by Tocher's method. The maximum inter cluster distance was recorded between cluster IV and IX ($D^2=451.74$), whereas minimum inter cluster distance was found in between cluster I and cluster V ($D^2=97.59$). The canonical analysis revealed that differentiation for thirteen characters among sixty nine genotypes was completed in five phases indicated the importance of days to 50% flowering, number of primary branches plant⁻¹, number of capsule plant⁻¹, 1000 seed weight, seed yield plant⁻¹, seed yield plot⁻¹, days to maturity and plant height for selecting parents respectively. The canonical analysis and cluster means study revealed the importance of 50% flowering, number of primary branches plant⁻¹, number of capsule plant⁻¹, 1000 seed weight, seed yield plant⁻¹ and plant height as contributors to the total divergence. The parents NL 115, NL 394, NL 392, NL 409, NL 420, NL 414, NL 414, NL 418, NL 384, NL 375, NL 417, NL 387, NL 388, NL 412, NL 422, NL 423, NL 421, NL 422, TL 16, TL 24, NL 428, NL 397, NL 395, NL 383 and NL 399 are significantly superior over the checks for no. of capsules plant⁻¹ and seed yield plant⁻¹ and seed yield plot⁻¹. On the basis of the present study it will be advisable to evaluate all these parents in preliminary yield trial along with standard checks as they have the maximum intercluster distance with those clusters involving checks and also significantly superior mean performance for seed yield plant⁻¹, seed yield plot⁻¹ and no. of capsules plant⁻¹. This conclusion is drawn from the fact that clusters containing these genotypes are highly divergent from clusters containing the check varieties. These genotypes on hybridization with existing check varieties may also be used for improvement of the check varieties.

Keywords: Genetic divergence, Linseed, Clusters

EFFICACY OF THERAPEUTIC NUTRITION IN MANAGEMENT OF HAEMODIALYSIS PATIENTS DURING SARS COVID-19 PANDEMIC

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COVID-19 is a contagious disease caused by SARS(Severe Acute Respiratory Syndrome). It mainly affects lungs but it can also affect multiple organs such as kidney, heart, digestive system, nervous system, etc. Infection has been reported in all ages and all vulnerable group. All vulnerable groups and patients with co-morbidities like diabetes mellitus, hypertension, and cardiovascular disease are susceptible to covid-19 infection. Covid-19 infection presents a special threat to patients on dialysis. Patients on haemodialysis has less lymphopenia, lower serum levels of inflammatory

cytokines , and milder clinical disease than other covid-19 patients. Patients with uremia are particularly vulnerable to infection and may exhibit greater variation in clinical symptoms. Kidney involvement seems to be frequent in this infection and it is an independent predictor of mortality. Management of patients on dialysis who have been suspected to have been in contact with COVID-19 should be carried out according to nutritional management is important. Patients on haemodialysis and with covid-19 should provide adequate amount of antioxidants with high high protein diet and limited fluids to prevent from covid-19 and maintenance of haemodialysis.

Keywords : efficacy , therapeutic , nutrition , haemodialysis , pandemic.

IMPORTANCE OF LEAFY VEGETABLES IN DAILY DIET AND IRON ENRICHMENT THROUGH BIOFORTIFICATION

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Iron is one of the most important micronutrients essential for human subsistence which is available in our diet through different vegetables and especially the leafy vegetables. Leafy vegetables are the reservoir of different vitamins and minerals including iron. According to Indian Council of Medical Research (ICMR) recommendation, 125g of leafy vegetables per capita should be included in daily diet. It is estimated that 100g of tropical leafy vegetables can provide 60-140 mg of vitamin C, 100 µg of folic acid, 4-7 mg iron and 200-400 mg of calcium. Iron deficiency anaemia is a threat throughout the world, more specifically for women and children which results in weakness, extreme fatigue, pale skin, chest pain, headache etc. To mitigate this problem iron fortification of leafy vegetables or other iron rich vegetables may be a best alternative. Enrichment of iron content of these leafy vegetables as well as increasing the bioavailability of iron can be done mainly following three different processes that include agronomic fortification, iron fortification through conventional breeding and fortification by transgenic means. Among these, agronomic iron fortification through mineral fertilization is the easiest method, but it is not sustainable whereas breeding requires much more time, technical efforts and initial investment during the early stages of variety development but after development of biofortified or iron fortified variety it becomes very cost effective and sustainable. However, the highest percentage of research has been made in transgenic fortification, though its rate of success is very less due to requirement of long period of time, fewer acceptances to the people and also other government and non government regulations. Considering all the aspects of different iron fortification methods, still biofortification provides a bright future to address malnutrition challenges including iron deficiency anaemia especially in the third world country.

Keywords: Leafy vegetables, Iron, Biofortification,

ISOLATION AND IDENTIFICATION OF URIC ACID DEGRADING ORGANISMS IN INFESTED FOOD MATERIALS

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Objective: To isolate and to identify the microbial strains that degrade the uric acid present in the infested food commodities.

Hypothesis: The food grains are stored in the godowns as buffer stock. The insect infestation is the major problem during the storage of the food grains in the gunny bags and also in bulk quantity. The insects release quinone, uric acid and exuvia during its development and leads to contamination in the food materials. These contamination leads to health issues when the food materials are used for consumption.

Method: Suspend one gram of each infested wheat flour, maida and rava were done in conical flask with 99mL of distilled water and kept in shaker (120rpm) for 24hrs. The spread plate method was done with the nutrient agar containing uric acid (0.03%) with different dilutions. The microbes grown in NA-UA media were allowed to grow in the enrichment media which is composed of 0.08 % Uric acid; 0.02 % K₂HPO₄; 0.005% KH₂PO₄; 0.001% MgSO₄, 7H₂O; 0.001% NaCl; 0.001% CaCl₂; and maintained pH at 7.5. The fungi were isolated with Rose Bengal- Chloramphenicol agar (RBCA) containing uric acid (0.03%). The bacteria were isolated by using the growth media (NA-UA) and the fungi strains were isolated by the RBCA-UA media that showed the presence of clear zone around the microbe that degrade the uric acid added in growth medium.

Result: It was found that two bacterial strains and three fungal strains are present. They were isolated and the studies were conducted on morphological characterization.

Implications: The one of the bacterial strains is Gram-positive, rod shaped in cluster and other one of bacterial strain is Gram-positive, round shaped in cluster form. The fungal strains showed septate hyphae and swollen vesicles gives rise to the conidia chains.

Future works: The identification of microbial strains can be done by 16S rRNA sequencing. The growth of both bacterial and fungal strains can be controlled by using the herbal and medicinal plant extracts. This study will be done by the antimicrobial activity against the microbes.

Keywords: Insect infestation, uric acid contamination and uricase degrading microbes

COMPARATIVE STUDY OF VARIOUS MOLECULAR TECHNIQUES

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Different molecular diagnostics techniques such as enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR), real time-polymerase chain reaction (RT-PCR) and DNA-labeled hybridization probes have been developed or implemented for the routine detection of various diseases including biological indexing. However, most of these diagnostic methods are time consuming and requires sophisticated laboratories, skilled manpower, not user-friendly and complex procedures as well as thermal cycler. In contrast to the existing amplification techniques, Recombinase polymerase amplification (RPA) is simple, cost-effective, rapid, user-friendly and sensitive. Thus, RPA was able to detect the target virus when the template was in crude extract

while PCR was not. PCR has become one of the most commonly-used nucleic acid based methods for the detection of plant pathogens due to its speed, specificity and sensitivity but the disadvantages of PCR/RT-PCR for detection are the dependence on a thermo-cycler and the time investment per sample. While RPA employs a single primer pair and operates satisfactorily over a convenient temperature range (39-45°C). RPA can also perform much faster and more cost effective assay than PCR. Thus, RPA could prove great potential to provide an improved diagnostic tool for detection of plant viruses.

Keywords: Molecular diagnostics, Pathogen, Polymerase chain reaction, Recombinase polymerase amplification

CRISPR-CAS9 A POWERFUL TOOL FOR GENOME EDITING

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The adverse changes in the climate have posed a serious threat in sustainable agriculture. In order to increase the yield of production as well as the quality of the crop there has been development of new robust tools. CRISPR-Cas9 is a recent emergence in crop improvement. It is a genome editing technology based on RNA-guided engineered nucleases. It has successfully been applied in several plants including wheat, maize, rice, sorghum, tomato, sweet orange and soya bean. CRISPR-Cas9 cleavage coupled with homology-directed repair has enabled engineering of new alleles, gene knock-downs or sequential addition of transgenes at the same locus. By using gene knockout, it targets DNA or RNA as a way of protecting against viruses and other mobile genetic elements. The Cas9 nucleases are properly guided to the target loci and results in double strand break followed by DNA- repair pathways. Alleles responsible for environmental stress, fungal pathogens and virus infecting in plants can be deleted or altered in a positive way. CRISPR-Cas9 is a simple yet robust system for genome editing in plants which acts as a tool to fix crop losses. Enhancement of disease resistance against plant pathogens and the production of bioedited crops will play a significant role in the field of agriculture. Being an easy and affordable tool, CRISPR-Cas9 promises to revolutionize basic and applied plant research.

Keywords: CRISPR-Cas9, Disease resistance, Engineered nucleases, Gene knockout, Genome editing.

EVALUATION OF THE BIO-EFFECTIVENESS OF SABUJ GOLD AS ORGANIC MANURE ON TOMATO, BRINJAL AND FRENCH BEAN

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The present study on “Evaluate the bio-effectiveness of Sabuj Gold as organic manure on Tomato, Brinjal and Chilli” was carried out at the Instructional Farm, Faculty of Horticulture of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar during rabi season of 2017 - 2018. In this experiment three experiment trails based on organic manure as supplemented by “Sabuj Gold” and combination with inorganic package of practice were evaluated to study their comparative performance on different growth, yield and quality related traits of three major rabi season crops namely tomato, brinjal, chilli. Results recorded showed that all the growth, yield and quality parameters were improved significantly against the other treatments which included the combination of organic and inorganic inputs as well as inorganic input alone. Maximum plant height was 68.97cm (Tomato), 58.96cm (Brinjal) and 55.24cm (French bean), the highest fruit yield per hectare was 31.97tonnes (Tomato), 18.74tonnes (Brinjal) and 8.94tonnes (French bean), the highest total leaf chlorophyll content was 418.11mg/100g, lycopene 4.27mg/100g and β carotene 1.37 mg/100g(Tomato) recorded with the application of Sabuj Gold as organic manure.

Keywords: Sabuj Gold, Organic manure, Tomato, Brinjal, French bean, Growth, Yield and Quality.

SOCIO-ECONOMIC PROFILE OF BENEFICIARY FARMERS UNDER TRIBAL SUB-PLAN (TSP) PROJECT OF CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL IN MEGHALAYA

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Tribal Sub-Plan Project (TSP) project was executed by College of Post Graduate Studies in Agricultural Sciences (CPGSAS), Central Agricultural University (CAU), Imphal during the crop year 2016-17 in two agriculturally important districts of Meghalaya namely Ri-Bhoi District and West Garo Hills District to enhance the socio-economic status and livelihood security of the tribal farmers through need-based agricultural technological interventions. In the present study, beneficiary farmers of Tribal Sub-Plan (TSP) project was surveyed to study their socio-economic profile. Complete enumeration sampling was employed giving rise to a total of 390 beneficiary farmers. A pre-tested structured schedule was prepared and personal interview was conducted respectively. The study concluded that majority of the respondents belong to 30 to 42 years of age, female was more in numbers than the male counter parts, maximum of them are marginal farmers with an average of ₹1,47,463 as annual income.

Keywords: Tribal Sub-Plan, socio-economic, livelihood security and beneficiary farmers

INFLUENCE OF DIFFERENT DATE OF SOWING ON GROWTH AND YIELD OF MAIZE AND GREENGRAM INTERCROPPING

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In northern parts of West Bengal recently the area of *rabi* maize has increased significantly. Increasing the popularity of rice-maize cropping system in this area and accepting the fact that both of them are exhausting crop, an alternate cropping system is to sustain in long run for which legume crops may be incorporated as an intercrop to maintain the soil health. Maize is normally grown at wider row spacing and inter row space can profitably be utilized for higher returns. Green gram, being a short duration pulse can successfully fit well in intercropping with maize. One of the most important factors contributing to yield gap is sowing of maize on inappropriate dates. In spring planted maize damaging effects of low temperature at seeding stage and of high temperature on pollination cause reduction of yield. So, to evaluate the proper planting time for maize-green gram intercropping, in the *terai* region of West Bengal a field experiment was laid out in split plot design having five main-plot treatments {D₁ = 3rd meteorological week (17 Jan); D₂ = 4th meteorological week (24 Jan); D₃ = 5th meteorological week (31 Jan); D₄ = 6th meteorological week (7 Feb); D₅ = 7th meteorological week (14 Feb)} and four sub-plot treatments {C₁= Sole maize; C₂ = Sole green gram; C₃ = Maize+ green gram (1:1) and C₄ = Maize+ green gram (1:2)} with three replications. Maize variety DHM 117 and green gram variety Pusa Baisakhi were taken in the study. Individual plot size of 4 m x 3 m was maintained in the trial. From the experiment it was observed that early planted maize took more number of days to germinate and 50% tasseling compared to late planted maize. It was also found that among the different dates of sowing, D₄ was superior in terms of growth and yield compared to other dates of sowing.

Keywords: Intercropping, Dates of Sowing, Meteorological Week.

**MICROGREENS: REVEALING ITS ANTIOXIDANT AND MICRONUTRIENT
POTENTIAL**

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Malnutrition problem has always been a matter of concern. With the growing population the problem is growing intense. A bunch of research is being conducted to make the crops fortified with nutrients to eradicate the problem of malnutrition especially in poor class. Microgreens has emerged as a special category crops and are gaining momentum in recent years due to highly nutritious and their ease of cultivating methods. They are enriched in minerals, vitamins and antioxidants and hence potent to prevent from various diseases and deficiencies. The nutritional values of microgreens have been count higher than their mature counterpart quantities. How much the agricultural practices good may be but a loss of nutrients may be definite when it comes from farm to plate. Hence the average nutritional diet's value is reduced. New innovative ideas are required to feed the burgeoning population. Microgreens are crops obtained with minimized environmental impacts. Microgreens can be easily cultivated and it takes minimum resource demands i.e. water, soil and pot or tray. Commonly grown microgreens are mustard, spinach, beetroot, lettuce, cilantro, cabbage, radish and broccoli.

FOLIC ACID AND ITS REQUIREMENT IN PREGNANCY

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Neural tube defects (NTDs), serious birth defects of the brain and spine, are a major, preventable public health burden. Globally, it is estimated that approximately 300,000 babies are born each year with NTDs (Christianson *et al.*, 2006), resulting in approximately 88,000 deaths and 8.6 million disability adjusted life years (DALYs) (WHO, 2015). In low income countries, NTDs may account for 29% of neonatal deaths due to observable birth defects (Blencowe *et al.*, 2010). As morbidity and mortality from infectious diseases are decreasing worldwide, the contribution of birth defects to under-5 morbidity and mortality will continue to increase proportionally (Rudan *et al.*, 2010). Women who are pregnant or might become pregnant take folic acid to prevent miscarriage and "neural tube defects." Birth defects that occur due to folate deficiency such as spina bifida, when the fetal spine and back do not close during development. Folate and folic acid are forms of a water-soluble B vitamin. Folate occurs naturally in food, and folic acid (pteroylmonoglutamic acid) is the synthetic form found in dietary supplements and fortified foods (Tamura and Picciano, 2006). Folic acid is a pregnancy superhero! Taking a prenatal vitamin with the recommended 400 micrograms (mcg) of folic acid before and during pregnancy can help prevent birth defects of your baby's brain and spinal cord (<https://www.webmd.com/baby/folic-acid-and-pregnancy>). During early development, folic acid helps form the neural tube. It is very important because it can help to prevent some major birth defects of the baby's brain (anencephaly) and spine (Spina bifida) (<https://www.cdc.gov/ncbddd/folicacid/about.html>). Foods that are naturally high in folate include leafy vegetables (such as spinach, broccoli, and lettuce), okra, asparagus, fruits (such as bananas, melons, and lemons) beans, yeast, mushrooms, meat (such as beef liver and kidney), orange juice, and tomato juice. Studies were searched using google scholar and more than 100 research articles as well as review were found in which about 30 research articles and about 10 review articles met the criteria of my search topic on folic acid and its requirement in pregnancy. Images were directly taken from google search. Folate is required for normal growth and division of cells. Along with B12, folic acid helps in the transmethylation of homocystein to methionine, ethanalamine to choline and uracil to thymine. The synthesis of purine and pyrimidine bases needed for synthesis of DNA and RNA. Periconceptional intake of folic acid is known to reduce a woman's risk of having an infant affected by a neural tube birth defect (NTD). National programs to mandate fortification of food with folic acid have reduced the prevalence of NTDs worldwide (Crider *et al.*, 2011).

GENOME EDITING: AN EMERGING TOOL FOR PLANT BREEDERS

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Conventional plant breeding has contributed enormously towards feeding the world and has played crucial roles in the development of modern society. The conventional method creates variation by transferring genes between or within the species. In general, these methods are more expensive and take more time, to overcome these limitations, new technology is required. Genome editing is a powerful tool for biotechnology applications, with the capacity to alter the function of any gene.

With the availability of gene information for the majority of the traits, genome editing emerged as a potential to create a new variation with the introduction of any transgene. The important genome editing tools used nowadays are ZFNs, TALEN, Pentatricopeptide repeats protein, adenine base editor, RNA interference, and CRISPR/Cas9. These tools have opened a new era for crop improvement. Due to the complex genetic architecture of most traits, it is challenging to edit genes controlling them. To overcome these challenges, genome editing provides a broader perspective. Among the above-mentioned tools, CRISPR/Cas9 is the most powerful tool for gene editing. These technologies are being used to create abiotic and biotic resistance crop varieties.

Keywords: Conventional method, Cluster regularly interspaced short palindromic sequence, Genome editing, RNA interference, and TALEN.

SMALL RUMINANTS' BREEDING: STATUS, CHALLENGES & OPPORTUNITIES IN THE HIMALAYAS, NEPAL

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Present study has been carried out mainly aiming at assessing the current status of small ruminants' breeding, and its challenges and opportunities in the himalayan region of Nepal. Study mainly involved review of available literatures including journals, proceedings, and other technical and scientific reports. Findings suggested that sheep and goats are the main small ruminants reared for the economic, food and nutritional security in the region. *Baruwal* and *Bhyanglung* of sheep and *Chyangra* and *Sinhal* of goat are the important genetic resources requiring specific breeding and conservation initiatives. Study also revealed that the government of Nepal owns more than a dozen of acts, policies and regulations associated to livestock breeding and conservation. However, scientific breeding practices are being poorly implemented in the country. Furthermore, breeding small ruminants in the Himalayan region of Nepal is still based on indigenous knowledge and traditional practices leading to decreased production and productivity due to inbreeding. Selection is being rarely practiced under transhumance herds because of free ranging and uncontrolled herding. Programs for improving the production and productivity of small ruminants are little been carried out in the mountain flocks. Because, several challenges of livestock breeding lie on addressing inaccessibility of geography, developing physical infrastructure, retaining skilled human resources, developing niche specific breeding scheme, technology adoption and its sustainability in the Himalayan region. However, these challenges provide a great scope to the breeders, scientists, researchers and academicians to work on breeding and improvement of small ruminants in the himalayan region of Nepal in future to come.

Key words: Small Ruminants, Breeding, Indigenous AnGR, Selection

PREVAILING AQUACULTURE PRACTICES IN ROHTAS DISTRICT OF BIHAR

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SMS, KVK, Rohtas

A fact-finding study was carried out for a period of one year in Rohtas district, of Bihar to assess the current aquaculture practices. The study revealed that 93.3% fish farmers were Hindu, 98.2% were male, and 78.2% belong to the age group 41-60 years. Most of the aquaculture farmers had basic literacy (98.5%) and possess medium size family (65.2%). Aquaculture activity in Rohtas district was dominated by Pangassius fish species (98.2%) in combination with IMC & EMC. The pond areas of 83.56% farmers were less than 0.50 ha with an average depth of 1.5 m practicing semi-intensive type farming (71.23%). The water color of most fish ponds (95.5%) was slightly green and 94.3% respondents used ground water for farming. Commercial fish feed was used to the tune of 81% and twice feeding frequency were adopted by 96.7% of fish farmers. Mustard oil cake and rice bran were the commonly used farm made feed ingredients and ABIS commercial feed were used by the most respondents (58%). The annual income of 61.8% farmers was below Rs. one lakh. Disease outbreaks (86%), poor quality of fish seeds (61.4%), lack of extension services and technical knowledge (86.9%), were major problems among the fish farmers. The baseline information on the current aquaculture practices can play vital roles in sustainable aquaculture production.

Keywords:Rohtas, Pangassius, Semi-intensive

FIELD EFFICACY OF SULFOXAFLO 120SC AGAINST THE GREEN PEACH APHID, *Myzuspersicae* AND SELECTIVITY TO THEIR NATURAL ENEMIES IN POTATO ECOSYSTEM

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The green peach aphid, *Myzuspersicae* (Sulzer) (Hemiptera: Aphididae) is considered as one of the major pests affecting potato production causing both direct damage by feeding on the plants and indirect damage as a virus vector. The management of this aphid vector is necessary to reduce the spread of viral diseases, and prevent yield loss. The bio-efficacy of Sulfoxaflor 120SC against *M. persicae* on potato was investigated. The experiment was conducted at Lingadahalli village of Chikkamagaluru district for two seasons (Kharif 2018 and Rabi 2018-19). The aphid population declined significantly (0.86 aphids/plant) with Sulfoxaflor 12% SC @ 27g ai/ha followed by Sulfoxaflor 12% SC @ 24g ai/ha (1.32 aphids/plant) as compared to control (14.46 aphids/plant). There was no phytotoxicity effect was noticed on potato by any of the concentrations of Sulfoxaflor tested. Besides, Coccinellid population was more or less uniform in both treated and untreated plots. The results clearly indicated that Sulfoxaflor 120 SC is a promising insecticide for managing *M. persicae* in potato ecosystem.

Baseline susceptibility studies on diamond back moth, *Plutellaxylostella* LINNAEUS TO SPINETORAM 6% W/V (5.66% W/W)+METHOXYFENOZIDE 30%W/V(28%W/W) IN INDIA

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Diamond back moth, *Plutellaxylostella* a serious pest of crucifers has developed resistance to many new insecticide molecules with unique modes of action. Bioassays for different populations of DBM from Hyderabad (TL), Guntur (AP), Ottanchatram (TN), Pune (MH), Raichur and Chikkaballapura (KAR) were conducted using leaf dip bioassay method to know the effectiveness of spinetoram 6% w/v (5.66 % w/w) + methoxyfenozide 30 % w/v (28.3% w/w). A known concentration of (20 ppm to 70 ppm) insecticide solution was prepared including control which was replicated five times. For each concentration 5 leaf discs were dipped for ten seconds, later air dried on petri plates. On drying ten second instar larvae were released into each disc and the mortality was recorded at 72 hours. Results indicated that there was a proportionate increase in the mortality of larvae with the increased concentration of insecticide. Based on LC₅₀ values of spinetoram+ methoxyfenozide calculated using Probit analysis, Raichur population was considered as relatively susceptible (22.83 ppm) followed by Chikkaballapura (24.35 ppm) and Hyderabad (24.73 ppm). Ottanchatram and Pune DBM population showed relatively high resistance (27.54 ppm each), respectively followed by Guntur population (27.31 ppm). Whereas, computed relative resistance ratio at LC₅₀ in comparison with relatively susceptible strain (Raichur population) varied from 1.06 to 1.20 folds.

Keywords: Diamond back moth, *Plutellaxylostella*, Baseline susceptibility, Spinetoram, Methoxyfenozide

DEVELOPMENT AND EVALUATION OF VALUE ADDED BANANA-GUAVA CHEESE USING SOYA PROTEIN ISOLATE AND WHEY PROTEIN ISOLATE POWDERS

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The health awareness among the people of world is rising day by day and it leads to demand of food product that contains functional ingredients. Due to this demand and needs of people, protein rich banana-guava cheese was developed using soya protein isolate and whey protein isolate powder (2, 4 and 6%). Cheese variants supplemented with 2% soya protein isolate powder and 4% whey protein isolate powder were found most acceptable and selected for preparation and evaluation of protein rich banana-guava cheese. The cheese was developed using 40% banana and 60% guava pulp. The other ingredients include 70 g butter, 900 g sugar, 5 g salt and 4 g citric acid for one kg pulp. Blending pulp of two different fruits like banana and guava helps in improving the nutrition and overall acceptability of the product. The banana-guava cheese was evaluated for changes in chemical parameters at monthly interval for three months storage period. This product is very popular among children due to its excellent taste and flavour.

Keywords: Banana, guava, protein rich and cheese

DIFFERENT GROWING SEASONS OF OKRA EFFECTING THE PATHOGENICITY OF ROOT-KNOT NEMATODE (*Meloidogyne javanica*) IN OKRA

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Okra (*Abelmoschus esculentus*), being a kharif season crop, its sowing has been recommended starting from February-March to July under Haryana conditions. Root-knot nematode (*Meloidogyne* spp.), being a serious pest of okra, is poikilothermic organism and its development is usually dependent on temperature and moisture content present in soil. So, the experiments on pathogenicity of *M. javanica* were carried out under three different growing seasons *i.e.*, spring (March-April), summer (May-June) and monsoon (July-August) for studying the effect of *M. javanica* on plant growth parameters as well as nematode reproduction and multiplication. With increase in inoculum levels from 10 to 10000 J₂/kg soil, there was significant reduction in all growth parameters. But the inoculum level of 1000 J₂/kg soil was observed to be pathogenic during spring and summer season while during monsoon season, 100 J₂/kg soil was found pathogenic to okra crop. The nematode reproduction and multiplication factors were observed in increasing trend with increase in inoculum levels of nematode under all the three growing seasons. The reproduction factor was observed negatively correlated with increasing inoculum level of nematodes. At 10000 J₂/kg soil, minimum reproduction factor was observed. The prevailing temperature during all seasons and soil moisture during monsoon season due to higher rainfall were crucial factors for reproduction and multiplication of *M. javanica*.

Keywords-*Abelmoschus esculentus*, Growth parameters, *Meloidogyne javanica*, Pathogenicity, Nematode reproduction

IN VITRO EVALUATION OF FUNGICIDES AGAINST LEAF BLIGHT DISEASE OF SUNFLOWER CAUSED BY *Alternaria helianthi*

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Sunflower (*Helianthus annuus* L.) belongs to the family Asteraceae. Sunflower is infected by many numbers of pests and diseases which causes huge losses annually worldwide. Among them, leaf blight caused by *Alternaria helianthi* is the most devastating disease in Karnataka. Even though plant disease management starts with many management practices like exclusion and eradication however, chemical management would be rapid method for disease control in crops. Disease management by means of chemical usage is the most predominant practice. As there is no resistant variety/hybrid available against *Alternaria* leaf blight, it has become inevitable to go for the management of the *A. helianthi* through fungicides. The fungicides were evaluated for their efficacy against *A. helianthi* under laboratory condition by following poison food technique. Out of 21 different fungicides tested (non systemic, systemic and combi fungicides) against *A. helianthi* of sunflower, all the fungicides inhibited the growth of pathogen. Mancozeb exhibited the mean maximum mycelial inhibition of the pathogen with 72.78 per cent which was on par with propineb with inhibition of 70.68 per cent and least performed non systemic fungicide was sulphur with mycelial inhibition of 24.81 per cent. Among systemic fungicides, difenconazole, hexaconazole, propiconazole and tebuconazole were found to be the best which inhibited the mycelial growth up

to 100.00 per cent at all the concentration used and thiophanate methyl had shown least inhibition of 37.40 per cent. Among combi fungicides, propiconazole + difenconazole (TASPA) showed cent per cent inhibition at all the concentration followed by carbendazim + mancozeb (SAAF) with mean mycelial inhibition of 94.87 per cent which was on par with zineb + hexaconazole (Avtar) which showed the mean mycelial inhibition of 94.44 per cent and least inhibition was noticed in tricyclazole + mancozeb with mean mycelial inhibition of 83.95 per cent.

Keywords: Sunflower, fungicides, *Alternaria* leaf blight

IMPACT OF ECOPHYSIOLOGICAL FACTORS AND BIOFERTILIZERS ON GROWTH PERFORMANCE IN BANANA CV. GRAND NAINÉ UNDER PUNJAB CONDITIONS

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Banana (*Musasp.*), one among the stable fruit crop for major human population are amenable for cultivation in regions of tropics and sub-tropics. An investigation was performed to assess the influence of environment and certain biofertilizers over the performance of open field cultivation of banana cv. Grand Nainé at Lovely Professional University, Punjab during 2017-2018. The study revealed clearly that the prevailed winter from November 2017 to January 2018 during the panicle emergence stage recorded negative impact with the growth and development of the standing crop with open field condition. As a result, the clear cut visible symptoms of crop deterioration *viz.*, pseudostem breakage, withering and expression of physiological disorder like 'Choke throat' documented. Although, the application of biofertilizer combinations expressed positiveness in the treatment fortified with *Azospirillum*(200g/plant) + PSB (50g/plant) at early crop growth stages with bunching and finger characters.

Keywords: Banana, Ecological factor, Biofertilizers, Panicle emergence and Winter injury.

EVALUATION OF REPRODUCTIVE PROFILING OF AMUR CARP WITH SPECIAL REFERENCE TO DIFFERENT TYPES OF FEED

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Proper nutrition is one of the most important factors influencing the ability of fishes to attain the genetic potential for growth, reproduction and longevity. Food quality and quantity affect fish reproduction. Adequate protein is essential for egg development, spawning, formation of follicles, ovarian tissues, growth and development of embryo. Dietary protein significantly affects fertility, gonad maturation, fecundity, hatching and viability of fish eggs and larval growth. Egg size and composition are useful indicators of seed production in terms of hatchability and larval quality. The present study was conducted to evaluate the effect of individual ingredient of feed on the serum biochemical parameters and serum hormones *viz* estrogen & testosterone of male & female of amur carp. Three diets were prepared *viz* high protein, lipid and carbohydrates separately & fed to the experimental species. The eight months study revealed that the high protein and lipid diet showed better results in all aspects evaluated. Sperm motility, spermatocrit, dead and live sperm ratio, ova diameter, gonadosomatic index, & hepatosomatic index, were also studied.

Keywords: Nutrition, Reproduction, Gonad maturation, Amur carp

EFFECT OF DIFFERENT SOURCES OF NITROGEN LEVELS ON SOIL AND LEAF NUTRIENT CONTENT OF APRICOT

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Effect of different sources of nitrogen levels on chemical properties of soil and leaf nutrient composition of apricot cv. 'New Castle' was carried out at HR&TS, KVK, Kandaghat, Solan, Himachal Pradesh during the year 2017 and 2018. The experiment have been composed of eleven treatments i.e., T1:100% nitrogen (N) of recommended doses of fertilizers applied through calcium nitrate(CN), T2: 100% through urea, T3: 25% N (CN) + 75% N (urea), T4: 50% N (CN) + 50% N (urea), T5: 75% N (CN) + 25% N (urea), T6: 22.5% N (CN) + 67.5% N (urea) + 10% N (vermicompost), T7: 45% N (CN) + 45% N (Urea) + 10% N (vermicompost, T8: 67.5% N (CN) + 22.5% N (Urea) + 10% N (vermicompost), T9: 20% N (CN) + 60% N (Urea) + 20% N (vermicompost), T10: 40% N (CN) + 40% N (Urea) + 20% N (vermicompost, and T11: 60% N (CN) + 20% N (Urea) + 20% N (vermicompost). Application of different sources of nitrogenous fertilizers had shown significant changes in soil chemical properties and the nutrient compositions in leaf. Treatment second recorded the maximum soil nitrogen content and leaf nitrogen, manganese, iron, copper, and zinc with minimum soil pH. Significantly higher soil and leaf phosphorus along with potassium content were estimated in the treatment nine.

Keywords: Apricot, nitrogen levels, chemical properties, recommended doses of fertilizers

EVALUATION OF SYNTHETIC AND NEEM BASED INSECTICIDES AGAINST APHID *Macrosiphum euphorbiae* THOMAS IN TOMATO UNDER MID HILL CONDITIONS OF HIMACHAL PRADESH

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The investigations were carried out on evaluation of some synthetic and neem based insecticides against the aphid, *Macrosiphum euphorbiae* Thomas in tomato during the Kharif season of 2020 at the experimental farm of Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan Himachal Pradesh. There were eight treatments viz., T₁- Imidacloprid @0.5ml/lit, T₂- Lambda cyhalothrin @0.75ml/lit, T₃- Azadirachtin @1.5ml/lit, T₄- Azadirachtin @3.0ml/lit, T₅- Azadirachtin @6.0ml/lit, T₆- NSKE @5%, T₇- NSKE @10% and T₈- Control (water only). Each treatment was replicated thrice in a randomized block design. The crop was sprayed at the appearance of the aphid and the data on pest population were recorded on 1, 5, 7 and 10 days after the spray. The results of the study revealed that there was significant reduction in the population of the aphid and the highest mortality (5.23 aphid/ 3leaves/ plant) i.e 82.00% was recorded with Imidacloprid (T₁) @0.5ml/lit followed by Lambda cyhalothrin (T₂) @0.75ml/lit (5.73 aphid/ 3leaves/ plant) which was 72.86% and significantly different from all the other treatments T₃, T₄, T₅, T₆ and T₇ while these treatments i.e. T₃, T₄, T₅, T₆ and T₇ were statistically at par with each other. The reduction in pest population was lowest in Control (T₈) (11.33 aphid/ 3leaves/ plant) after

the spray. Significantly higher yield 450 q/ ha was recorded with the Imidacloprid (T₁) while the minimum yield of 330 q/ ha was observed with Control (T₈). Hence, Imidacloprid @0.5ml/lt was quite effective in controlling the aphids, *Macrosiphum euphorbiae* in tomato.

Keywords: Tomato, aphid, Imidacloprid, Lambda cyhalothrin, Azadirachtin and Neem Seed Kernel Extract

ORGANIC FARMING FOR SUSTAINABLE CROP PRODUCTION

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Organic farming is centuries old human and natural intervention which has been eco-friendly and economically viable. It comprises eco-friendly agricultural techniques leading towards the maximum production without using chemical inputs. Nature friendly farming approach helps in reducing the negative effects of environmental pollution by recycling crop rotation, using crop debris, farm yard manure, pest control with biological methods, appropriate tillage, cultivating legumes to add organic matter in the soil and to mitigate the climate hazards. A majority of rural population in India is willing to adapt the organic farming practices to save their input costs for better livelihoods. The farm-home women are playing a great role in agricultural development and livestock management. Organic farming is efficient for eco-system providing a balance in the life of human, crops and animals; hence leading to the sustainability of the system.

India is one of the agricultural based Nations with more than two third of the population is directly or indirectly involved in agricultural sector. Before 1960, in India only traditional agriculture was followed without intervention of synthetic and chemical fertilizers and pesticides. There was threatening to food security to fulfil the hunger of the population and frequent climatic aberrations during late 1960s. The Government of India had entered into the path of so called green Revolution. There was increase in production and productivity at that time and our country was able to satisfy partly the food security.

During the last two decades, there has been a significant sensitization of the global community towards environmental preservation and assuring of food quality. The promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almost a century of development, organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people. In this article, study is done about present status, scope and future potential of organic farming in India in global perspective.

Keywords: Agricultural development, Food security, Future prospects, Sustainability, Organic farming

**SEASONAL INCIDENCE AND MANAGEMENT OF ONION THRIPS *Thrips tabaci*
LINDEMAN: CULTURAL AND CHEMICAL CONTROL PERSPECTIVE
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Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is a major pest of onion in India and causes significant yield losses of up to 37% of the bulb yield. It is detrimental to all crop growth stages and their occurrence; peak is largely influenced by weather factors. As thrips infestations can quickly reach high numbers, knowledge of pest abundance is necessary in order to minimize potential infestations by using all possible control tactics prior to chemical intervention. In this background a study was undertaken at various locations to assess seasonal dynamics of *T. tabaci*, the effect of the planting date on its occurrence and to evaluate the newer insecticide for its management. Seasonal dynamics of *T. tabaci* revealed significant variation among the locations and difference in population intensity and time of peak activity. Irrespective of locations, population peaks were mostly recorded between 4th to 15th standard meteorological weeks. Role of weather factors in population regulation was evident and peak population was noticed with in T_{max} range of 28 to 36°C and T_{min} of 11 to 24°C. Plantings dates had significant influence on the infestation of onion thrips. Rabi plantings (November to January) succumbed severe thrips attack while *kharif* and late *kharif* plantings (July to October) had low thrips population. This might be probably due to prevailing climatic condition, with special reference to rainfall. Locations like Srinagar, Dharward, Rajgurunagar, Samastipur and Chiplima had higher thrips load and are appear to be hot-spots. Further, study of newer chemistry insecticide Cyantranilprole 10.26 OD in different locations revealed that cyantranilprole alone and in combinations with fungicides showed a substantial reduction in thrips over control in many of locations and at bars at with fipronil in few locations. Thus the outcome of seasonal dynamics suggests that vigorous pest monitoring is required 4th to 15th SMW to establish timely management strategies so as to prevent the economic loss. Planting dates identified as less vulnerable for each location could be adopted to avoid peak by adjusting sowing. The insecticide cyantranilprole can be integrated into thrips IPM programme.

Keywords: *T. tabaci*, population dynamics, cultural control, cyantranilprole, IPM

**EFFECT OF BIOFERTILIZERS WITH LEVELS OF FERTILIZER ON GROWTH OF
ONION BULBS**

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The experiment was conducted at Horticultural Research Farm, College of Agriculture, RVSKVV, Gwalior (M.P.) during Rabi season 2018-19 and 2019-20. The treatments included combination of different bio-fertilizers and RDF. The experiment was laid out in randomized block design (RBD) with 15 treatments replicated thrice. Application of bio-fertilizer with different dose of fertilizers had significantly enhanced the growth of plants. Maximum plant height (33.73 cm, 47.83 cm, 67.23 cm and 74.10 cm), length of leaves (31.07 cm, 44.10 cm, 62.60 cm and 67.93 cm), width of leaves (0.77 cm, 0.91 cm, 1.38 cm and 1.58 cm), no. of leaves (5.90, 8.18, 11.73 and 12.97), neck thickness (6.42 mm, 8.82 mm, 11.31 mm and 13.21 mm), leaf area (81.73 cm², 320.23 cm², 838.23 cm² and 829.23 cm²) and leaf area index (0.54, 2.13, 5.59 and 5.52) were recorded under treatment T15 – 100% RDF + Azospirillum + Azotobacter + PSB at 30, 60, 90 and 120 days after transplanting, respectively. While, minimum values of all growth observations were recorded under T1 (Absolute control).

Keywords: Biofertilizers, fertilizers, growth, onion, Agrifound light red (AFLR) etc

**MODELLING SUITABLE HABITATS FOR RHEUM WEBBIANUM ROYLE IN
PIR PANJAL AND ZANSKAR HIMALAYAN RANGES USING POPULATION
DYNAMICS AND MAXENT APPROACH: A CONSERVATION PERSPECTIVE FOR
VULNERABLE MEDICINAL HERB**

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Prediction and mapping of potential suitable habitats for vulnerable species is critical for monitoring and restoration of their declining populations in natural habitat. Ecological niche modelling combines species occurrence points with environmental raster layers in order to obtain models for describing the probabilistic distribution of species. Present study reports on potentially suitable regions for reintroduction of a high value vulnerable medicinal herb (*Rheum webbianum*) in Union territories of Jammu and Kashmir and Ladakh using population attributes and MaxEnt Modeling. In this prediction 37 occurrence records with 19 bioclimatic variables, altitude and slope were used. The model predicted that the suitable habitats of *R. webbianum* were restricted to an area of ≈ 380 km² in the Pirpanjal and Zanskar sub-ranges of Indian Himalaya. MaxEnt map output gave the habitat suitability for this species while as model's internal jackknifing revealed that *ascii20* and *ascii9* were the most influential and collectively contributed for 60.7% to the MaxEnt model. As per permutation importance, *ascii18* had the maximum influence on the habitat model and contributed to 46.5%. Results of AUC (area under ROC) were statistically significant (0.924) and line of predicted omission is very close to omission on training samples, validating better run of the model. Response curves revealed probable increase in the occurrence of *R. webbianum* with increase in *ascii8* and *ascii5* and decrease with increase in *ascii14* and *ascii9*. Direct field observations concurrent with MaxEnt internal Jackknifing showed the role of elevation in determining the habitat distribution of *R. webbianum*. Population status was positively correlated with higher model thresholds in the greater elevations confirming the usefulness of the habitat model in population monitoring, particularly in predicting the successful establishment of the species. The study delineated the potential habitats in the higher elevations of North West Himalaya within and around the current home range where the species can be reintroduced.

Keywords: Ecological niche modelling, *Rheum webbianum*, MaxEnt, North West Himalaya, fisheries, dairy, poultry, home science etc.

**PERCEPTION OF CASHEW NUT MARKETING IN AGENCY AREAS OF WEST
GODAVARI DISTRICT ANDHRA PRADESH**

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Cashew (*Anacardium occidentale L.*) is one of the important cash crop in the study region and has a potential to provide source of livelihood as it has adaptability to varied agro-climatic conditions. India stands first in cashew production in the world accounting for 39.47 per cent of world production. Andhra Pradesh stands first with 1,24,876 Ha. of area and third in terms of production with 1,05,324 MT. In west Godavari cashew is one of the major plantation crops grown in mostly in

agency areas with an area of about 23,379 ha. with a production of 11,689.5 t and productivity 753 kg/ha. The study focused on the perception of tribal cashew farmers about cashew nut marketing in agency Areas of west Godavari district Andhra Pradesh. It further examined the socio-economic characteristics of cashew farmers, identified the sources of information as regards cashew nut marketing, determined the various marketing outlets available and evaluated the contributions of cashew nut marketing to farmers. Interview schedule was used to obtain information from 120 respondents. Findings show that majority of the respondents were male (69.3%), married (91.7%) and had farming experience within the range of 20 to 40 years (59.00%). Many of the farmers had farm size below 2 ha (51.7%). Major source of information to the marketers in the study area was through family, friends and neighbouring farmers (67.7%) while major marketing outlets available to the farmers were the middle men (52.3%). The major challenge to cashew nut marketing was unstable prices (97.00%). Respondents' age, educational qualification and farming experience, socio economic status were significantly correlated to the contributions of cashew nut marketing to the farmers. Therefore, the study recommended that government should give priority to the establishment of a proper marketing channel and price control regulation for cashew farmers to prevent the extortion of middle men.

Keywords: perception, cashew nut marketing and tribal cashew farmers

ISOLATION, IDENTIFICATION, MOLECULAR CHARACTERIZATION AND ANTIBIOTIC RESISTANCE PROFILING OF BACTERIAL ISOLATES COLLECTED FROM WATER BODIES OF DISTRICT RAJOURI, J&K

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Antibiotics-powerful drugs for the control of various infectious diseases are one of the important discoveries in modern medicines. Their unrestricted and wide use has created a pressure on bacteria, resulting in the development of antimicrobial resistance. Bacteria, the most extended form of life in our planet have demonstrated a great flexibility and can be found in all environments from ices to boiling waters, from extreme pH's to overwhelming pressures. Bacteria have proven to be much more innovative and adaptive in developing resistance. Throughout years resistance spread at a massive scale in microorganisms through mutation, horizontal gene transfer and selective pressure created by use or misuse of antibiotics. Clinical infections caused by multi drug resistant bacteria or becoming more difficult or even impossible to treat with current antibiotics, leading to infections causing higher morbidity and mortality, imposing huge costs on our society. In the current study, a survey of different sites of district Rajouri was done and different water samples were taken in order to screen out the bacterial isolates for variable antibiotic treatments. A total of 8 non-duplicate bacterial isolates was obtained. These bacterial isolates were identified by biochemical test kit. Different plant extracts were employed to study their effects on these bacterial isolates. The isolates of bacteria showed different range of sensitivity resistance for different classes of antibiotics having different mode of action. Out of 8 bacterial isolates, three isolates were found resistant and five isolates showed intermediate phenotype for Colistin. Similarly, four isolates were found resistant and two isolates showed intermediate phenotype for Polymyxin. All 8 bacterial isolates were found sensitive to Rifampicin, Tetracycline and Piperacillin/Tazobactam. A total of 7 isolates were found

sensitive to Amikacin. In our study, we found different plant extracts effective against wide variety of bacteria that offers greater perspectives in their exploitation as alternatives to available therapeutics in treating different diseases.

Keywords: Antibiotics, Resistance, Bacteria, Water samples, Isolates.

PRECISION AGRICULTURE, SOIL AND WATER MANAGEMENT FOR SUSTAINABLE FARMING

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The technological amelioration in this domain can help the farmers to increase productivity by optimal use of resources. Agriculture needs precision at every step to result in a better yield of the product. Selection of genetically superior seeds according to the field and weather condition is the primary requirement to initiate the farming activity. Predictive analysis using various machine learning models can be useful in predicting the best time to sow a particular seed and keep track of environmental impacts on crop yield. Crop and soil monitoring is another necessity to ensure better productivity. Computer vision and deep learning find its use in processing the captured data mostly through drones. Some software-based technology is also accessible in monitoring crop and soil health. The agriculture sector is projected to receive reduced water allocation despite the increasing pressure for more food production. Together, the increasing food demand and decreasing water allocations suggest that the agriculture sector has to produce more food with less water. Economic value of water in agriculture is much lower than that in other sectors. By applying various scientific methods such as making small dam in fields, canals etc. we can harvest rain water also for irrigation purposes. Controlling the weed is necessary to protect the crops as most of the weeds are resistant to herbicides and cause significant damage to the productivity of the field. By leveraging the computer vision to distinguish precisely the weed from the actual crop, we can limit the use of chemical sprays. A drone capturing the entire field can give us the exact location where the spray is needed. Precision spraying can prevent the unwanted chemical from coming into our food. Crop and soil health monitoring can be done very quickly using remote sensing and GIS. A deep learning application is capable of reporting the potential defects and nutrient deficiencies in the soil. Simple image recognition technology can lead us to monitor the health of crops and land up to 95% of accuracy. By employing the very basics of the recent advancements in technology, we can achieve a very satisfactory result. I want to work on this idea, though it is not affordable by many of the farmers but can be implemented wisely to benefit most of the farmers. The farmers don't need to carry smartphones to make use of this system of the application. A region-wise dashboard, according to the prevalent weather condition data and other yield and resources data collected from the farmers can do the job. This system of applications accumulated together can suggest the farmers on the mass basis regarding the primary necessities of seed type selection, the need for irrigation, the need for particular nutrient replenishment. Crop health monitoring through drone imaging is difficult to achieve for a large proportion of farmers in India. But the implementation of this technological amelioration in the field of agriculture can serve as a small step for revolution.

Keyword: Agriculture, Water conservation, Crop health, Soil health, Technology

EUCALYPTUS TREES PLANTATION: A REVIEW ON SUITABILITY AND THEIR BENEFICIAL ROLE

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Eucalyptus is fastest growing species popularly known as gum tree, red iron tree, safeda and belonging to the family Myrtaceae. More than 700 species have been recorded, most of them native to Australia. *E. tereticornis* and *E. grandis* are important commercial species with a clean straight bole and compact crown. Large scale plantations have been raised on forest and farm lands, community lands, field boundaries and road/rail/canal strips in India. It is most suitable species for degraded land, waterlogged areas, problematic soils etc. Although, it is a controversial tree because of high water consumption, nutrient depletion, allelopathic effects, suppression of undergrowth etc., but it is also source of pulp and paper, essential oil, honey, timber, medicinal use, etc. moreover it also provides ecological, socioeconomic and industrial services. Improvement in physical and chemical properties of soil on Sodic wastelands, heavy metal accumulation in different tissues of eucalyptus in mined soil, drawdown of water table in water logged area were reported in studies. On the basis of unit weight of dry biomass produced, it consumes very little water compared to other trees. If bark is left on site, the balance of nutrients remaining on the site is 83, 87, 63, 83, and 82 percent of inputs for N, P, K, Ca and Mg. In the face of growing economy and increased demand for wood products, Eucalyptus remains to be the desired species that grows fast and produce wood to meet the demand of wood for fuel, construction and furniture materials. Relieving wood product scarcity, landscape re-greening, contribution to poverty reduction, biodiversity restoration and conservation are valuable contribution of eucalyptus in forest sector. Emphasis should be given by environmentalists, researchers and policy makers to support land users and growers in selecting the appropriate place of planting and managing planted trees, so that the environmental and ecological impacts are minimized and the socio- economic benefits were optimized.

Keywords: Eucalyptus, Waterlogging, Salinity, Paper and Pulp wood etc.

SURVIVAL TIME OF COVID -19 OUTSIDE AN INFECTED PERSON

RENU AGARWAL

INPG COLLEGE, MEERUT

The coronavirus (covid-19) is expelled by an infected person, even if he is asymptomatic or presymptomatic without wearing a mask, through breathing, coughing, sneezing or talking, in form of small mucus/saliva droplets laced with virus from the nose or mouth. The heavier droplets quickly sink to the ground or settle on nearby objects or surfaces. These include door handle, light switches, tabletop, faucets, sheets towel etc. this also happen when humidity is high, when the virus carrying droplet is dragged down by gravity and not remain suspended in air. There they can remain infectious upto 3 to 4 days at room temperature and high humidity until rendered inactive with disinfectants. if the temperature is high humidity or sunlight is coming on object, surface, when humidity is low their life span is vastly reduced. However the smaller droplets can travel upto 2 meter and 3 to 4 times more, if there is slight breeze in the environment. If the air is polluted with dust/gas particles (aerosol), they can settle down on them, of size PM 10 (10 nanometers) or bigger and remain suspended in air for hours, specially in closed indoor space (patient wards, supermarkets,

residential building, toilets etc.) . A centrally air conditioned building spread the virus in entire building space in no times. The Indian Medical Association(IMA) has recommended to use fans instead of AC,s this summer. There should be proper ventilation and sterilisation to reduce the airborne virus exposure.

Keyword:Coronavirus, covid-19, humidity, PM-10, asymptomatic.

MECHANISM OF RESISTANCE IN BENEFICIAL INSECTS VS PESTS'

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Resistance to pesticides among insect- pests is a problem that has increased with the modernization of agriculture meanwhile the sensitivity of beneficial insects to insecticides is on the other hand a big challenge. Some of the most marked differences occur in three superfamilies glutathione S-transferases (GSTs), cytochrome P450 monooxygenases (P450s) and carboxyl/cholinesterases (CCEs), encoding xenobiotic detoxifying enzymes. Specifically there are only about half as many GSTs, P450s and CCEs in the honeybee. This includes 10-fold or greater shortfalls in the numbers of Delta and Epsilon GSTs and CYP4 P450s, members of which clades have been recurrently associated with insecticide resistance in other species. These shortfalls may contribute to the sensitivity of the honeybees to insecticides. On the other hand there are some recent radiations in CYP6, CYP9 and certain CCE clades in *Apis mellifera* that could be associated with the evolution of the hormonal and chemosensory processes underpinning its highly organized eusociality, also contributing sensitivity to insecticides. Among the arthropods, the greatest resistance occurs in the order Diptera, followed by Lepidoptera, Coleoptera, Hemiptera and mites. Multiple resistance mechanisms, including penetration resistance through thickening of the cuticle, metabolic resistance by increased activities of detoxification enzymes (e.g. cytochrome P450 monooxygenases and esterases), and knockdown resistance by *kdr* mutations, have been identified as conferring insecticide resistance to insect- pests. Unfortunately, resistance does not evolve at the same rate in species or population of beneficial insects as in pest species. Resistant pest species outnumber resistant beneficial species i.e. pollinators, predators and parasitoids.

Keywords: Resistance Mechanisms, Detoxifying Enzymes, Beneficial Insects, Pests

ASSESSMENT OF NUTRITIONAL STATUS OF THE FARM FAMILIES BY ORGANICALLY CULTIVATED NUTRI GARDEN

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The main objective of the study was to assess the impact of nutrition garden in farmer's field. The study was conducted for two years in Gidnahalli village, Chikkaballapura taluk and Marinayakanahalli village, Chintamani taluk, Chikkaballapur district. The farm families of 50 were randomly selected and made into three groups based on their family size; Large (6-8), Medium (4-6) and Small (2-4) where the total families were 10, 20 and 20 respectively. The total number of participants were 240, where males were 139 and 101 were females. *BMI classification showed that, underweight was most prevalent both in females (66.66%) and males (54.05%) respectively. Forty one females were suffering from nutritional anaemia followed by 24 suffered

from iron deficiency. Clinical symptoms like scaly skin, angular stomatitis, skin lesions were observed among 37 children due to micro nutrient deficiencies. About 53 adults were suffering from Osteomalacia and Osteoporosis. Cross sectional design was inculcated and farm families were selected on the availability of the area, water and willingness of farm women to maintain the garden in all the seasons. Along with the vegetable seed kits perennials, fruit crops, super foods and medicinal plants were also supplied. Farm families were introduced to the concept of organically growing nutrition garden through on campus training programs on balanced diet and importance of micronutrients. The nutritional composition of Recommended Dietary Allowance (RDA) was computed using Nutritive Value of Indian Foods and compared the same with the nutrients intake. The percentage adequacy determined revealed that there was an increase in per cent of quantity of nutrients intake like proteins (21.82%), fibre (13.83%), vitamin A(23.87%) , vitamin C (15%), Iron (14.29) and Calcium (18.34%). After introduction of nutritional garden, the consumption of fresh vegetables increased in the daily diet which contributed towards the upliftment of the nutritional status of the farm families.

Keywords:Nutrigarden, Nutrition, Organic and *Body mass index (BMI)

CHARACTERIZING HUMIC ACID FROM DIFFERENT ORGANIC SOURCES AND ITS APPLICATION ON QUALITY AND YIELD OF CAPSICUM

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An experiment was conducted at farmers field of Bangalore rural district to assess the effect of humic acid (HA) extracted from different organic sources viz., coffee pulp, press mud and poultry manure and applied at two different levels viz., 60 and 90kg ha⁻¹ along with Recommended dose of fertilizer (RDF) on quality and yield of capsicum. Among the different sources humic acid extracted from poultry manure recorded higher nitrogen(6.01) and oxygen (44.85) with higher molar ratios, N/C and O/C (0.13 & 0.99., respectively) followed by press mud and coffee pulp. The field experiment showed that application of RDF + HA 90 kg ha⁻¹ extracted from poultry manure resulted in significantly higher TSS (6.57 °Brix) and ascorbic acid (144.23 mg 100 g⁻¹) followed by (RDF + HA 90 kg ha⁻¹ extracted from press mud) and (RDF + HA 90 kg ha⁻¹ extracted from coffee pulp) than in control with TSS (4.66 °Brix) and ascorbic acid (125.19 mg 100 g⁻¹), Similar was the trend with yield, maximum yield (55.41 t ha⁻¹) was obtained with application of HA extracted from poultry manure followed by press mud (54.68 t ha⁻¹) and coffee pulp (54.34t ha⁻¹) than control (42.32 t ha⁻¹). Thus application of HA extracted from poultry manure @ 90 kg ha⁻¹ in combination with RDF resulted in improving the quality and yield of capsicum

Keywords:Humic acid (HA), poultry manure, press mud, coffee pulp, yield, TSS, Ascorbic acid Recommended dose of fertilizer (RDF)

THERAPEUTIC EFFECT OF VITAMIN E ON HISTOLOGICAL STUDY OF LIVER AND KIDNEY AND HEMATOLOGY IN HEXAVALENT CHROMIUM INDUCED LABORATORY CHICKS

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Objective - To investigate the therapeutic effect of Vitamin E on histological study of liver and kidney and hematological parameters in hexavalent chromium induced laboratory chicks.

Hypothesis - Hexavalent chromium compounds have been shown to manifest toxic and carcinogenic effects in humans and animals. Vitamin E has been reported for its antioxidant property clinically or preclinically. However, more scientific research is yet to be done on its protective effects in chicks.

Methods - Potassium dichromate ($K_2Cr_2O_7$) (5mg/ 100gm body weight, orally) was used to induce toxicity in chicks. Vitamin E (0.5 IU/ 100gm body weight) was administered (intramuscularly) to the chromium treated chicks on each alternate day for 30 days. The study was carried out on three groups namely, Chromium treated group, Chromium treated and Vitamin E administered group and normal control group; by assessing histopathological study of liver and kidney and hematological parameters including RBC, WBC, Hb, PCV and MCHC at the end of the study period.

Results - The histopathological evaluation of liver and kidney tissues showed severe changes in chicks treated with $K_2Cr_2O_7$. Administration of Vitamin E protects the liver and kidney damaged by $K_2Cr_2O_7$ as evidenced by normal histological structures, although in some tissues hemorrhage was also noticed. Hematological parameters Hb, WBC, RBC, PCV, MCHC showed significant ($p < 0.05$) decrease in chromium supplemented chicks as compared to control group. While, in the group co-treated with chromium and vitamin E, the value of these parameters increased.

Implication - Vitamin E has a potential protective effect to reverse the toxicity of $K_2Cr_2O_7$ and has the ability to improve the hepatic and renal tissue damage associated with $K_2Cr_2O_7$ intoxication. Similarly, the progressive toxic effects of hexavalent chromium on hematological parameters can be moderately reduced by administering vitamin E in laboratory chicks.

Keywords : Hexavalent chromium, Vitamin E, Hematological parameters, Liver, Kidney.

CORRELATION AND PATH ANALYSIS STUDIES ON YIELD AND IT'S COMPONENTS IN MUNG BEAN [*Vigna radiata* (L.) Wilczek]

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Present study included 70 mung bean breeding lines and 20 yield and yield attributing traits. The correlation coefficients among 20 traits with their path effects towards seed yield were studied. The analysis of correlation coefficient suggested that magnitude of genotypic correlations were higher than the corresponding phenotypic correlations. In present study, phenotypic and genotypic correlation of seed yield was positive and significant with days to 50% flowering, days to maturity, primary branches per plant, clusters per plant, pods per plant, pod length, 100-seed weight, shelling %, biological yield per plant and harvest index. This suggests while selecting for improvement in seed yield these characters can be kept in mind provided the character should show high variability,

which is basis for selection. However, seed yield per plant showed significant and negative association with protein content in both genotypic and phenotypic correlation studies. Hence, these traits also can be emphasized while selecting for improvement of seed yield. The path coefficient analysis revealed that biological yield per plant had highest direct effect on seed yield per plant followed by harvest index, days to maturity, number of clusters per plant, number of pods per plant, pod length, number of seeds per pod, number of pods per cluster, 100-seed weight both at genotypic and phenotypic level, whereas seed hardness, days to shattering and primary branches per plant at genotypic level only. This suggested that emphasis should be given to these traits in selection programme for improvement of seed yield in mung bean.

Keywords: Correlation, Mung bean, Path analysis

MULTIVARIATE ANALYSIS IN MUNG BEAN [*Vigna radiata* (L.) Wilczek] FOR THE STUDY OF GENETIC DIVERSITY

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The present investigation included seventy mung bean breeding lines. They were evaluated for 20 different characters at Agricultural Research Station, Badnapur under Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. The mean values were worked out for genetic diversity by Mahalanobis D^2 statistic. The results of D^2 analysis indicated presence of considerable genetic diversity among these lines. Inter-cluster and intra-cluster distances were worked out. Inter-cluster distances were ranged from 240.96 (between cluster V and cluster VII) to 1080.72 (between cluster V and cluster VIII). The inter-specific derivatives were grouped into eight clusters. The maximum inter-cluster distance was between cluster V and cluster VIII (1080.72), followed by cluster II and cluster III (932.25), cluster IV and cluster VIII (910.11), cluster VII and cluster VIII (738.30), cluster I and cluster VIII (732.61), cluster VI and cluster V (660.49) and cluster II and cluster VI (494.93). This suggested that there is wide genetic diversity between these clusters. Based on these studies, crosses can be made between breeding lines of these clusters to obtain desirable results either in transgressive breeding or in heterosis breeding. Cluster VIII and cluster IV showed high mean values for most of the yield contributing traits like 100-seed weight, shelling %, harvest index, pod length, primary branches per plant, days to 50% flowering, days to maturity, leaf width and days to shattering. So the lines from cluster IV and cluster VIII can be used for mung bean yield improvement programme.

Keywords: Genetic Divergence, Mung bean, D^2 analysis, Principal Component Analysis.

POST-HARVEST PROCESSING OF GREEN BANANA

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India being a largest producer and consumer of banana in the world and its area and production has been increasing at a fast pace, the post-harvest losses of this highly nutritious fruits are quite serious in our country. Generally wastage of this fruit before it reaches the consumer is due to lack of proper processing and storage facilities. Therefore in order to overcome these losses, one effective method would be by converting it into various commercial banana products. India is the largest producer and consumer of banana and it shares about 33.4 per cent of the total fruit production of country. Green banana cannot be eaten as raw, hence further processing is required. Green banana peel contains many medicinal properties and health benefits. About 2.5 per cent of production of banana is processed different types of value added products such as fried chips, dehydrated chips, pulp, powder and green banana peel soups, peel chutney etc. These products are gaining wide popularity in our day-to-day life due to change in life style. The development of value added products in production catchment area will improve the market effectiveness and add extra income to the farmers which will help in enhancing their economic conditions and generate employment for rural youth.

Keywords: Green banana, Value addition, banana peel, Health benefits

STUDIES ON ETHNIC BEVERAGE COCONUT TODDY PREPARED IN A STANDARDIZED METHOD, IN A VISION TO FIND GLOBAL ACCEPTANCE OF THE INDIGENOUS TECHNICAL KNOWLEDGE (ITK)

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Sweet sap (*Padaneer*) samples were collected from well matured coconut palm variety (TXD & EC Tall) from villages in Karikal taluk of Puducherry and stored in refrigeration. The stored samples were membrane filtered (cellulose nitrate filter, 0.45 μ m) in ambient temperature. The membrane filtered sap was further passed on through two different packed glass columns: activated charcoal and polyurethane (PU) foam immobilized *Bacillus* sp. (odour removing bacterial culture) and then collected. These experiments improved maximum removal of the 'off' odour from the sap. Parameters viz., pH and titratable acidity of raw, membrane filtered, activated charcoal filtered and *Bacillus* sp. Filtered; sap samples were recorded. It showed that the pH decreased and the titratable acidity increased as the fermentation time of sap increased. A gadget was designed with microbial filter and vacuum pump that could be hung to collect coconut sap from the palm inflorescence, thereby reducing the chances of contamination and further fermentation. The sweet sap so collected showed 1.26 per cent alcohol as against traditional tapping process with mud pot where the alcohol per cent is 5.23. Further, yeast isolation was carried out from the sap sample using Sabouraud Glucose Agar media and Glucose Yeast Peptone Agar media and was identified by their fermentation pattern. Studies were carried out using the identified yeast isolates for ethanol tolerance and optimum ethanol production. The isolate *Saccharomyces* sp. TRY 5 shown a maximum of 10% ethanol tolerance and mean optimum ethanol production of 31 g l⁻¹. The nutritive values of both fermented (using *Saccharomyces* sp. TRY 5) and unfermented sap were recorded by standard methods. This study was done to standardize the Indigenous Technical Knowledge (ITK) – Farmers' Innovation of making both coconut: *Padaneer* and toddy for global acceptance.

EFFECT OF FYM AND BIO DIGESTER LIQUID MANURE ON SOIL HEALTH IN FINGER MILLET BASED CROPPING SYSTEM

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Field experiment was conducted in organic plots of ARS, Balajigapade during 2019-20 to study the effect of graded levels of farmyard manure and biodigester liquid manure (BDML) on performance of finger millet. The soil was red sandy loam in texture, medium in organic carbon (0.54%), low in available nitrogen (148.17 kg ha⁻¹), high in available phosphorus (80.34 kg ha⁻¹) and medium in potassium (145.26 kg ha⁻¹). Significantly higher available nitrogen, phosphorus and potassium content was observed with application of FYM @ 10 t ha⁻¹ (173.9, 94.77 & 219.49 kg ha⁻¹, respectively) and BDLM @ 125% N equivalent (166.62, 95.54 & 224.3 kg ha⁻¹, respectively). Similarly combined application of FYM+ BDLM at higher dose (FYM 10 t ha⁻¹ + BDLM @ 125% N equivalent) resulted in significant build up of available N (175.36 kg ha⁻¹), phosphorus (94.79 kg ha⁻¹) and potassium (224.5 kg ha⁻¹) content of soil after the harvest of finger millet. Soil enzymes responsible for transformation of nitrogen (Urease), phosphorus (Phosphates) and organic matter decomposition (Dehydrogenase) showed significant difference with application of graded levels of FYM and BDML. However, higher enzymatic activity of urease (29.30 µg NH₄/g soil/hr), acid phosphatase (41.19 µg PNP/g soil) and dehydrogenase (63.59 µg TPF/g per 24hr) was recorded in treatment which received FYM @ 10 t ha⁻¹ + BDLM @ 125% N equivalent. Thus nutrient could be enhanced with combined application of FYM and BDML at higher dose, which was indicated by higher enzymatic activity.

Keyword: BDLM, Dehydrogenase, Farmyard manure, Finger millet, Urease

THE EFFECT OF TILLAGE SYSTEM ON SOIL CARBON AND ENZYMATIC ACTIVITIES

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Soil organic carbon and enzyme plays a crucial role in nutrient transformation in soil. Hence, referred as an important factor of crop productivity. Thus, a field experiment was undertaken to evaluate the effect of tillage and cover crop residue incorporation in Finger millet + pigeonpea intercropping system at AICRP for Dryland Agriculture, GKVK, Bengaluru during *khari* 2019. Three tillage methods viz., Conventional tillage (CT), Reduced tillage (RT), Zero tillage (ZT) with field bean (FB) and horse gram (HG) as cover crops, whose residues were incorporated after harvest in conservation agriculture (CA) based management, while CT based management was without any residue. The aim was to study influence of tillage and cover crop residue incorporation on soil organic carbon and soil enzymatic activity. The results indicated significant change in soil organic carbon by tillage and residue incorporation in CA – based management. Among different tillage methods, ZT recorded higher organic carbon (0.38 %) compared to CT (0.36 %). Incorporation of high biomass yielding horsegram residue resulted in higher buildup of soil organic carbon (0.42 %) compared to field bean (0.38 %). Similarly, tillage + residue incorporation showed significant increase on soil organic carbon. Where in ZT + HG cover crop residue incorporation recorded highest organic carbon (0.42 %) compared to CT without residue (0.27 %). Soil enzymes

responsible for transformation of nitrogen (urease) phosphorus (phosphatase) and organic matter decomposition in soil (dehydrogenase) were significantly affected by tillage and residue incorporation. The highest dehydrogenase activity (108.03 $\mu\text{g TPF/g soil/ 24 hr}$), urease activity (34.77 $\mu\text{g NH}_4/\text{g soil/hr}$) and acid phosphatase activity (43.03 $\mu\text{g PNP/g soil}$) were recorded in CA based management *viz.*, ZT with HG cover crop residue incorporation. The results of study showed a positive influence of conservation agriculture practices on build up in organic carbon.

Keywords: Conservation Agriculture, Cover Crops, Enzymatic activities, Finger millet, Pigeonpea

IMPACTS OF CLIMATE CHANGE ON KHARIF RICE PRODUCTION IN ODISHA

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Crop growth is highly sensitive to any changes of climatic conditions and the variability in climate also affects the crop production. Temperature rainfall and solar radiation are three important parameters related to climate change, which affects the crop yield of any region. In Odisha rice is a predominant crop of the *Kharif* season and its cultivation is highly dependent on rainfall. In the present study an attempt has been made to access the impact of these weather parameters on the productivity of a rulling rice variety Swarna in warm and humid region of Odisha using CERES-Rice model of Decision Support System for Agro technology Transfer (DSSAT) 4.6 version. The climate change projection has been estimated using four global climate change Representative Concentration Pathway (RCP) scenarios 2.6, 4.5, 6.0 and 8.5 for four future years 2030, 2050, 2070 and 2090 by using MarkSim GCM -DSSAT weather file generator. Under the projected climatic condition for the years 2030, 2050, 2070 and 2090, RCP 4.5, 6.0 and 8.5 scenarios, increasing trend is observed in seasonal maximum temperature, minimum temperature and decreasing trend in rainfall, found to cause major negative impacts on the grain yield of rice in *Kharif* season. A field experiment was conducted at Agrometeorology Field Unit to verify the growth, development and yield of four rice cultivars transplanted under four different dates of planting. The treatments were laid out in split plot design with dates of transplanting in main plots and varieties in sub plots in three replications. Tagged hill data, Leaf Area data were taken in fifteen days interval up to maturity. In this study growth, development and yield of rice *cv.* Swarna is verified under four different dates of planting. In *cv.* Swarna the increasing effect of seasonal temperature up to 1⁰C combining with increase in solar radiation and decrease in rainfall as per RCP scenarios causes increase in yield of *kharif* rice under RCP 2.6 scenario however, grain yield decreases with increase in temperature of more than 1⁰C along with solar radiation more than 2.5 MJ/day. The projected impact under RCP 4.5, RCP 6.0 and RCP 8.5 scenarios is much severe as compared to RCP 2.6 scenario on the grain yield characteristic of rice resulting in drastic decrease of the yield in future for the years 2030, 2050, 2070 and 2090. The maximum decrease of grain yield is expected to be up to 35% in 2030, 57% in 2050, 56% in 2070 and 59% in 2090 under all the RCPs except RCP 2.6, in all the four dates of planting, resulted in thinking of medium and short duration variety instead of long duration variety.

Keywords:Rice, Swarna, RCPs, Kharif, Climate.

UTILIZATION OF WILD RELATIVES FOR RESISTANCE BREEDING AGAINST BIOTIC STRESS IN TOMATO

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Tomato (*Solanum lycopersicum*) plant hosts more than 200 species of pest and pathogens. As a consequence of inbreeding during tomato domestication, the genetic diversity in cultivated tomato is very narrow (<5%). Breeders have exploited wild relatives for resistance to diseases for a century and over 42 resistance genes have been derived from *Solanum peruvianum*, *Solanum chilense*, *Solanum pennellii* and several other wild relatives and 20 of them bred into horticultural tomatoes. Most of the resistance governed by R-gene mediated resistance, quantitative resistance: longer lasting, 'durable'?. Most wild tomatoes have very small populations, making them vulnerable to extinction. Therefore, to discover and maintain species diversity in bio diverse region is extremely important. However, it is virtually impossible to exploit all individual wild accessions by generating genetic libraries of ILs, considering 75 000 *Solanum* accessions conserved in gene banks around the world. Utilisation of wild relatives has been expedited recently by application of various molecular genetic methodologies. With all the genomics expression and metabolite databases, breeder will select the best combinations of genotypes and design programmes to combine traits in new cultivars in a 'breeding by design' process.

Keywords: Tomato, wild accessions, Crop improvement

NANOTECHNOLOGY AND BIOREMEDIATION-A SYNERGY TO THE POTENTIAL ENVIRONMENTAL BENEFIT

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Due to certain properties of Nanoparticles like NPs can diffuse or penetrate into a contamination zone where microparticles cannot reach due to its nanosize and they have higher reactivity to redox-amenable contaminants. The size dependent behaviour of any particle relates to some of its unique properties. This gave rise to rapidly growing field of Nanosciences. Nanotechnology has attracted considerable interest of both scientific and industrial community in the past few years specifically in bioremediation. The bioremediation has been drawing increasing attention due to its economic, eco-friendly and self-propelling attributes. Nanoparticles (NPs) can be either applied directly for removal of organic contaminants through adsorption or chemical modification. They can also serve as a facilitator in microbial remediation of contaminants either by immobilising or through the induced production of remediating microbial enzymes. The use of nanomaterials initially reduces the biodegradable contaminants and then it promotes to achieve the standard levels. Thus, the role of nano-materials could be an efficient, effective approach to remediate the environmental contaminant sustainably. However, it is an open topic where more research is required to record the detailed fate of the nano-materials that are used in environment remediation. This review will provides an overview of different types of nano-technologies with biological and plant-based bioremediation approaches. Nanomaterials usage in degradation of waste and toxic material, which

will also decrease the cost of degradation of waste and toxic materials. Nanomaterials/nanoparticles not only directly catalyze degradation of waste and toxic materials, which is toxic to microorganism, but also it also helps enhance the efficiency of microorganisms in degradation of waste and toxic materials and delivering a sustainable approach.

Keywords: Nanomaterial, bioremediation, contamination zone, enzymes and degradation

MICROPROPAGATION OF CAPPARIS DECIDUA –A COHERENT APPROACH TO STUDY THE ANTIMICROBIAL POTENTIAL OF BIOSYNTHESED NANOPARTICLES IN MS MEDIA

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New contributions to *in vitro* techniques for plant propagation in the last decade have simplified micro propagation technology. There is wide genetic variability in the field population of Capparis decidua as it is an open pollinated plant. Capparis decidua are being depleted, since its fruits are used as a food. Hence planting stock is not available in required quantities. Plant tissue culture offers an opportunity for rapid multiplication of capparis decidua an important medicinal shrub of semi-arid region. The shoot tip and nodal segments were cultured on different MS Media combinations for respective growth parameters i.e. early bud outbreak, shoots per explants, shoot length, multiple shoot organogenesis, biomass accumulations (FW&DW), organic and moisture content, moisture percent of the regenerated plantlets, root induction and root length. MS-3 media containing 1 mg/LBAP+ 1mg/L NAA+15mg/L adenine sulphate and 0.2% activated charcoal was the optimum Medium. Nodal segment showed a bit late response for bud outbreak as compared to the shoot tips. RM-3 media was the best for highest root induction (73.3±6.6 %) after 3-4 weeks. Green synthesized SNP using leaf, stem and fruit extracts showed 1nm-20nm in size. The absorbance peaks was taken at 452nm, 460nm and 462nm from leaf, stem and fruit synthesized SNP, respectively. The antimicrobial effect of green SNP (100.0 mg/L) showed highest rate of survival of explants and decontamination in soaking experiment. The 150.0 mg/L was the best concentration when used in the media supplementation experiment. Green synthesised silver nanoparticles which are non-toxic and eco-friendly showed a good antimicrobial behaviour substituting the harmful chemicals of the plant tissue culture.

Keywords: Silver Nanoparticles, *Capparis decidua*, MS Media, Absorbance, PGR (Plant growth regulators)

MOLECULAR BASIS OF INHERITANCE AND TREE BREEDING

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Inheritance is the transmission of traits from parents to their offspring. On molecular level, traits are controlled by genes which are biochemical structures of nucleotides (A, T, C, G) further make chromosomes (visible at time of cell division) in a denser body nucleus. Some genes are not found on the chromosomes in the cell nucleus. Chloroplast and mitochondria contain their own genome which is inherited independently of nuclear DNA, and inheritance pattern of these organelles differs from nuclear inheritance i.e. uniparental, biparental and vegetative segregation.. Paternal inheritance of chloroplast and mitochondrial DNA was reported in *Sequoia sempervirens*. For forest trees, techniques to make breeding more efficient are especially valuable because of the long generation intervals. Traits of long lasting interest to tree breeders include growth and bole volume, wood properties and resistance to diseases. The increasing demand for wood and wood products and the reduction of available harvestable forests has recently led to introduction of several molecular and biotechnological tools into forest tree research and improvement. MAS have the potential to enhance gains and shorten the generation interval. Forest tree domestication and breeding programmes mostly started at the earliest in the last half century and are, therefore, still in infancy. The application of biotechnology to forest trees offers a great potential to hasten the pace of tree improvement for desirable end uses. Great progress has been made in constructing genomic maps of forest trees in the last few years. Genomic mapping now provides an important way to study forest genetics. The most valuable contribution that markers could make to breeding would be to save time by shortening the time before selection or to reduce the number of breeding cycles. Future directions for forest tree genomic research could be to acquire reference genome sequences for many genera of tree species. Improved phenotyping technologies are required to be developed.

Keywords: Inheritance, DNA, Markers, Genomic map etc.

COMPARATIVE STUDY OF DNA QUANTIFICATION OF FOUR SPECIES OF MALE AND FEMALE CHANNA

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The present study was conducted on DNA extraction and determination of DNA quantity of both male and female of four species of *Channa* viz. *C. gachua*, *C. marulius*, *C. punctatus*, *C. striatus* collected from three different sites of Western Uttar Pradesh. DNA isolation was done and gel electrophoresis was carried out and extracted DNA was analyzed using Nanophotometer (P330; Implen, Germany) to determine the quantity of DNA and its purity level. A total of 90 samples were analysed. The DNA content of *Channagachua* female was 52-70 ng/ μ l and of male was 61-74 ng/ μ l, of *C. marulius* was 52- 64 ng/ μ l and of male was 64-78 ng/ μ l; *C. punctatus* was 69-78 ng/ μ l and of male was 76-79ng/ μ l and of *C. striatus* was 60-72ng/ μ l and of male was 64-72ng/ μ l. For evaluation of interspecific variations, the DNA content variation among sex, type (species), site measured were analysed using generalised linear model by the analysis of the content variation was done using ANOVA (Univariate Analysis of Variance UNIANOVA using SPSS 20.0, Followed by POST HOC: DUNCAN'S Multiple Range Test), showed statistically significance in all Parameters (e.g., site, type, sex).

Keywords: *Channa*, DNA extraction, Nanophotometer, Interspecific variation.

STATUS OF AGRICULTURAL CREDIT AND ITS EFFECT ON AGRICULTURE IN BANGLADESH

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Agricultural credit is a crucial element of agricultural modernization and commercialization which ascertains sustainable development. The paper attempted to evaluate status of agricultural credit programs and its effect on agriculture. The study is based on secondary data extracted from various sources like Bangladesh Bureau of Statistics (BBS), Bangladesh Bank Publications, Bangladesh Economic Review (BER), and Ministry of Agriculture (MoA). Descriptive statistics and statistical methods were used in presenting results of the study. To discern the impact of credit on agricultural productivity panel data regression using Fixed Effect Model (FEM) and Random Effect Model (REM) were used. Hausman specification test was applied for selecting the best model between FEM and REM and to check the suitability of the technique. The results revealed that agricultural credit has expanded over the years with the collective efforts of scheduled banks and micro finance institutions. The growth rate of agricultural credit also increased over the decades i.e. from 3.33% during 1983-95 to 9.5% in 2008-2019. Although allocation of agricultural credit was increased strenuously but the percentages of agricultural credit over total credit were noticeably low (4-5%). In recent years, despite increasing actual disbursement over targeted but before 2010, actual credit disbursement never attained the defined target of agricultural credit disbursement. The results of FEM revealed that institutional (agricultural) credit, gross irrigated area and fertilizer had significant positive impact on agricultural output at division level. This indicates that agricultural credit directly influences the agricultural productivity. Therefore, for enhancing agricultural productivity there is need for more favorable agricultural credit policy which can increase the budgetary allocation and take efforts to overcome the targeted shortfall.

Keywords: Agricultural credit, growth rate, credit disbursement, panel data regression,

MARKER-ASSISTED BREEDING: OPPORTUNITIES FOR MAIZE IMPROVEMENT

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Maize (*Zea mays* L.) is one of the most prominent crops and major source of income for farmers throughout the world. It possess vast majority of nutrients including various fractions of micronutrients, which are necessary for balanced diet for millions of people worldwide. Marker-assisted breeding is a novel technology in modern era and it emerged as an integral tool for enhancing breeding efficiency and effectiveness in maize research programmes. This technique offers remarkable prospects for increasing the productivity and value of maize germplasm. It can be achieved through a combination of precise genetic mapping, high-resolution chromosome haplotyping and extensive phenotyping. Marker-assisted breeding is likely to become more valuable as a larger number of genes are identified and their functions and interactions are elucidated. Reduced costs and optimized strategies for integrating marker-assisted breeding with phenotypic

selection are much needed before the technology can reach its full potential. An extensive literature suggests that breeding programmes use molecular tools for meeting the challenge of developing improved cultivars with combinations of relevant adaptive traits, including biotic and abiotic stress tolerance, and nutritional quality efficiently. Significant progresses have been made worldwide for understanding the phenotypic and molecular diversity in maize, identification of QTLs traits, particularly tolerance to biotic and abiotic stresses, and marker-assisted breeding for improving nutritional quality and disease resistance. In recent years, remarkable progress has been made in some of the Asian countries, especially in China and India for developing biofortified maize varieties through marker-assisted breeding. Marker-assisted breeding should focus to develop commercially viable biofortified cultivars, which will improve the nutritional status and can ameliorate the most important constraints to maize production.

Key words: Maize (*Zea mays* L.), Marker-assisted Breeding and Biofortification

UNDERUTILIZED FRUITS CROPS AND TECHNOLOGIES FOR MEETING THEIR MARKET NEEDS

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Fruit crops are considered and categorized under protective food because of their richness in various phytochemicals minerals and vitamins. They are rich sources of certain soluble dietary fiber which reduces erratic bowel movements, aids in cholesterol and fats reduction from the body and helps in boosting the immune system. Underutilized crops may be termed as the crops, that are neither grown on a commercial or large scale nor are traded widely around the world. These crops fall under lesser recognized plant species in terms of research and marketing aspects but can be seen well adapting to wild and stress like conditions. Research worldwide researches have shown shreds of evidence of underutilized wild edible plants possessing great valuable nutritional value. Since ages, several underutilized indigenous fruit crops having medicinal properties are utilized in various indigenous medicinal systems like Ayurveda, Unani, and Homoeopathy. The popular processed products made from these fruit crops are jam, RTS, fruit drinks, chutneys, candies, pickles, squashes, concentrate, etc. These fruit crops are a rich source of vitamin C which has been proved as a boon in enhancing immunity in this COVID-19 pandemic times. These crops can even cure insomnia, scurvy, constipation hemorrhage, leucorrhoea, anemia, stomach ache, and can be used as a cooling agent to reduce sun strokes ill effects. Underutilized fruit crops can even adapt to low input agriculture. More research and development efforts in these crops will certainly add substantially to food security and nutrition. There is a need to develop high yielding varieties, production and protection technologies, and post-harvest management practices for these crops. Better coordination among all the agencies involved in research, development, and promotion will help popularize these fruit crops.

Keywords: Crops, Fruits, Horticultural, Nutritional importance, and Underutilized.

EFFECT OF NITROGEN, PHOSPHORUS AND POTASSIUM GROWTH, ESTABLISHMENT AND SURVIVAL PERCENTAGE OF MANGO (*Mangifera indica*L.) SAPLINGS CV.DASHEHARI IN ALLAHABAD AGRO CLIMATIC CONDITION

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A field experiment was carried out at Horticulture Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.) during September 2015 to January 2016. The experiment was laid out in randomized block design (RBD) with 12 treatments and each replicated thrice. The treatment T₈ (Nitrogen 78.84 g/plant, Phosphorus 19.44 g/plant and potassium 73.44 g/plant) was found to be the most suitable in terms of maximum plant height (84.27cm), maximum number of leaves (20.17), maximum leaf area (53.02cm²), maximum internodes length (4.58cm), maximum Stem girth (0.94cm). Among the various treatment T₀ (control) is recorded the lowest on observation of different parameters, while in terms of survival percentage of the plant, various treatment have significant effect on the plant.

Keywords: *Mangifera indica*, Nitrogen, Phosphorus, Potassium, Growth, Establishment, Survival Percentage.

EFFECT OF MUTATION AND EXPRESSION OF DEFENSE RESPONSIVE GENE AGAINST SHEATH BLIGHT (*Rhizoctonia solani*) IN RICE (*Oryza sativa* L.) VARIETY SWARNA

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Sodium azide (NaN₃) is a chemical mutagen, and widely used in crops to improve their yield and quality traits. We studied the effect of various concentrations of NaN₃ ranged (0.01%, 0.02%, 0.03%, 0.04%, 0.05%) on germination and seedling growth of rice. Control was distilled water at pH7. Viable grains were pre-treated in sodium azide solution (pH3) for 6 hrs. Germination was recorded from second day to fourteenth day after initiation (DAI). The differences were recorded in germination percentage, plumule length, radicle length and dry weight of sprouting grain. Germination at 2DAI is fastest in the control experiment than in the NaN₃ treated rice variety. There were no germination in 0.05% NaN₃ at fifth DAI. Germination % declined as NaN₃ conc. increases. The 50% germination was observed in 0.03% NaN₃ at 14DAI. There was no radicle formation at 2DAI in the seed that were pre treated with 0.04% and 0.05% NaN₃. Plumule length was lowest in 0.05% treated rice, starting at 5th DAI. Radicle and plumule were shorter as NaN₃ treatment increases. The present investigation was undertaken to identify the resistant lines amongst mutated rice population of the variety swarna induced by the sodium azide. The variability in disease reaction was observed among mutated rice lines. Out of the total 1000 mutant plants, 47 plants were screened that show low disease index, ranged between 0 to 5 were selected for next M generation. In M₂ generation the selected genotypes show differences for disease index, only 12

lines shows resistance in M2 generation in field condition and in humidity chamber condition only 8 lines shows resistance. The number of resistance lines were decreases in humidity condition. Non significant variation in morphological expression and in yield attributes among the selected mutants was also reported. The lines that shows resistance was confirmed by the expression of defense responsive in these lines. The gene RGA-2 (Putative serine/threonine kinase), PR1 (Pathogen related protein 1) and PR5 (Pathogen related protein 5) highly expressed in resistance lines, and 8G7 (transferase, transferring glycosyl groups) highly expressed in moderate lines as compare to resistance lines after inoculation of *Rhizoctonia solani*. Thus, these resistance lines could be considered a potential source for disease resistance against the sheath blight of rice and could be used further in the crossing programme for development of sheath blight resistant rice variety.

Keywords : Mutation , Rice , Sheath blight .

EUCALYPTUS TREES PLANTATION: A REVIEW ON SUITABILITY AND THEIR BENEFICIAL ROLE

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Eucalyptus is fastest growing species popularly known as gum tree, red iron tree, safeda and belonging to the family Myrtaceae. More than 700 species have been recorded, most of them native to Australia. *E. tereticornis* and *E. grandis* are important commercial species with a clean straight bole and compact crown. Large scale plantations have been raised on forest and farm lands, community lands, field boundaries and road/rail/canal strips in India. It is most suitable species for degraded land, waterlogged areas, problematic soils etc. Although, it is a controversial tree because of high water consumption, nutrient depletion, allelopathic effects, suppression of undergrowth etc., but it is also source of pulp and paper, essential oil, honey, timber, medicinal use, etc. moreover it also provides ecological, socioeconomic and industrial services. Improvement in physical and chemical properties of on Sodic wastelands, heavy metal accumulation in different tissues of eucalyptus in mined soil, drawdown of water table in water logged area were reported in studies. On the basis of unit weight of dry biomass produced, it consumes very little water compared to other trees. If bark is left on site, the balance of nutrients remaining on the site is 83, 87, 63, 83, and 82 percent of inputs for N, P, K, Ca and Mg. In the face of growing economy and increased demand for wood products, Eucalyptus remains to be the desired species that grows fast and produce wood to meet the demand of wood for fuel, construction and furniture materials. Relieving wood product scarcity, landscape re-greening, contribution to poverty reduction, biodiversity restoration and conservation are valuable contribution of eucalyptus in forest sector. Emphasis should be given by environmentalists, researchers and policy makers to support land users and growers in selecting the appropriate place of planting and managing planted trees, so that the environmental and ecological impacts are minimized and the socio- economic benefits were optimized.

Keywords: Eucalyptus, Waterlogging, Salinity, Paper and Pulp wood etc.

DEMOGRAPHY OF COLONIES OF ASIAN GIANT HONEYBEE, *Apis dorsata* FAB.

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The giant honeybee, *Apis dorsata* is known to be a major honey producer in the southern states of India. These colonies are highly migratory and travel for long distances during dearth seasons. A study was conducted on the demography of *A. dorsata* colonies in respect of arrival and departure of swarms in its well congregated regions in and around Bengaluru, Karnataka. The observations revealed that, *A. dorsata* swarms arrived at its congregation area during June and July, expanded their numbers, and showed gradual desertion of their colonies from January to April. The number of colonies in test congregation areas was varied from 20 to 250. However, the deserted colonies always left the barren combs behind, suggesting that they had left in response to deteriorating resource quality. The observation clearly show that, *A. dorsata* colonies exhibit annual migratory pattern and is a strategy of colony survivability to overcome from fluctuation in availability of pollen and nectar source and also the pests and diseases.

Keywords: *Apis dorsata*, nest congregation, demography, colony migration

**IDENTIFICATION OF MICROBIAL STRAINS PRODUCING HISTAMINE FROM
FERMENTED IDLY BATTER**

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Objective: To identify the Histamine producing microbial strains in fermented Idly batter.

Hypothesis: Idly is the common fermented food consumed by most of the population. Microbial spoilage of food can be caused by increased production of histamine which is a biogenic amine. The most commonly occurring biogenic amine includes putrescine, cadaverine, spermine, spermidine, tyramine, phenylethylamine, Histamine, tryptamine. The consumption of foods rich in Histamine can cause headaches, flushing, itching, hypotension, nasalsecretion, bronchospasm, tachycardia, urticarial, pruritus, and asthma. Food containing more than 1000mg/kg of histamine considered as toxic for human consumption Identification of such toxic amine producing strains is much-needed work in the current scenario. :Various Idly batter samples were purchased from the local market of Thanjavur and stored under refrigerated conditions for a week. Periodically sample took from stored Idly batter to identify the microbial strain responsible to produce histamine content in fermented Idly batter. Specific growth media helps in (Nivens agar medium) identifying the histamine producers present in the sample. The biochemical analysis helps confirm histamine producers, after the isolation of specific histamine producers, 16S rRNA sequencing to identify the strains responsible for histamine production. The strains responsible for histamine production in fermented Idly batter was identified successfully using microbial techniques.

Implications: The identification of histamine producers from fermented food is much-needed work to get rid of toxic substances produced. By identifying the microbial strains, control measures can be adopted in advance.

Future proceedings: RT-PCR based studies will be done to confirm the gene level presence of microbes in fermented Idly batter

Keywords: Biogenic amines, Histamine, 16S rRNA sequencing, RT-PCR

CITRUS ACT AS A WEALTH OF ACTIVE NATURAL METABOLITES THAT POTENTIALLY PROVIDE BENEFITS FOR HUMAN HEALTH DURING COVID 19
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Citrus is an evergreen shrub or small trees grown in tropical, sub-tropical and temperate regions and most extensively produced tree fruit crop in the world. Citrus belong to the family Rutaceae including Oranges, Mandarins, Tangerines, Limes, Grapefruits, Lemons, and Citrons. Genomic studies reveal that Lemons were indicated as a hybrid between the citron and the lime. Citrus fruits and juices contain a broad range of substances including carbohydrates, fibre, vitamin C, potassium, folate, calcium, thiamine, niacin, vitamin B6, vitamin A, phosphorus, magnesium, copper, riboflavin, pantothenic acid and a variety of phytochemicals. In Asia, it is known as *Citrus limon* (lemon), which has yellow ellipsoidal fruit and has notable nutritional and medicinal property. Under the presence situation in the spread of coronavirus, one of the preventive methods is to increase the body's immunity by eating foods that enhance immunity. Citrus fruits contain good amount of vitamin C which is found to be gearing immunity as well as they can help in defeating the virus. This paper provides an information towards the knowledge on nutritional, medicinal, phytochemical and pharmacological value of Citrus fruit. This study reveals the potentiality of natural products derived from Citrus fruit possess the useful chemical properties in the form of flavonoids, phenolics, carotenoids, terpenol, limonin, vitamin and essential oil products are responsible to cause alterations in the immunomodulatory and anti-viral properties. Also, this paper tried to explore the related information of Citrus fruit to the researchers towards a systemic research and development work should be undertaken for its medicinal value.

Keywords: Citrus, Vitamin C, magnesium, Flavanoids, Antioxidant, Antiviral

CAN PHOSPHATE SOLUBILIZING MICROORGANISMS RELEASE THE FIXED PHOSPHORUS (P) IN AN ALLUVIAL SOIL?: A STEP TOWARDS SUSTAINABLE P MANAGEMENT

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Phosphorus (P) deficiency is a serious problem in agricultural soils throughout the world limiting crop growth. Although most of the soils have appreciable amount of total P, but P present in plant-available form is generally very low and most of the P is present in fixed pool. Utilization of this fixed P in soil is an urgent need as the reserves of rock phosphate, raw material of phosphatic fertilizer production is declining rapidly. Use of phosphate solubilizing microorganisms (PSMs) to solubilize this fixed P in soil is a promising method in this regard. An incubation study was conducted in the laboratory for 90 days at ambient temperature to assess the release of P from alluvial soil of Delhi (order- Inceptisol, pH= 8.30) as influenced by PSMs by applying pure cultures of either phosphate solubilizing bacteria (PSB), *Enterobacter* sp. or phosphate solubilizing fungi (PSF), *Aspergillus niger* to the soil. On an average, both the microorganisms significantly increased

the release of P into solution from fixed P pool of soil. However, *Enterobacter* sp. treated soil showed better P release than that of *A. niger* treated soil. *Enterobacter* sp. was capable in mediating P release into soil solution during the whole period of incubation, whereas *A. niger* was able to mediate P release into soil solution only up to 28 days of incubation. So, *Enterobacter* sp. can be utilized as an alternate source of P nutrition towards plants grown in this alluvial soil.

TRADITIONAL AND HERBAL MEDICINES
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Traditional and Herbal Medicine are naturally found and are plant derived substances with no or very less industrial processing that are used to treat illness within local or regional healing practices. Many countries are known for their traditional treatments and Herbal medicines such as India, Japan, China and many more. Ayurveda is a primarily practiced in India that has been known for nearly 5000 years. It includes diet and herbal remedies, while emphasizing the body, mind and spirit in disease prevention and treatment. Herbal and traditional medicines are helpful to protect ourselves from Corona Virus also. For example: *Ocimum tenuiflorum* (Tulsi), *Tinospora cordifolia* (Giloy) are used to treat or prevent from fever. Combination of *Zingiber officinale* (Ginger) + Honey + Black Pepper is used to treat cough and congestion. Milk boiled with turmeric powder is very helpful to build the immunity of an individual which is very essential to fight against any disease. There are various other medicines that are used for prevention of many diseases.

GENETIC VARIABILITY AND CORRELATION STUDIES FOR YIELD AND YIELD CONTRIBUTING CHARACTERS IN ADVANCE LINES OF INDIAN MUSTARD (*Brassica juncea*)

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The present research was carried out to determine the best selection criteria for yield improvement in rapeseed (*Brassica juncea* L.). Fifty-four genotypes of *Brassica juncea* were sown at AICRP on Mustard at Nagpur (M.S), during the years 2018- 2019 to evaluate the components of variability (genotypic and phenotypic), heritability, correlation (genotypic and phenotypic) for yield and various yield components. High heritability along with high genetic coefficient variance were recorded for seed yield per hectare and seed yield per plot. Similarly, medium GCV along with high heritability were observed for number of siliques per plant and 1000 seed weight which indicated existence of substantial variation for these characters. High heritability indicated less influence of environment in expression of these characters and prevalence of additive gene action in the inheritance. Hence selection based on phenotypic observation for these characters would be effective. At phenotypic and genotypic level, thousand seed weight had significant positive correlation with number of primary branches, plant height, and yield per plot. A positive and highly significant genetic relationship was found between number of primary branches per plant, plant height and number of siliques per plant, days to maturity and 1000 seed weight. Therefore, these traits should be given more priority for selection in breeding programme.

Keywords: *Brassica juncea*, Correlation, Heritability, phenotypic, genotypic, variability

ECO-FRIENDLY MANAGEMENT OF POWDERY MILDEW OF LINSEED

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A field experiment was conducted during rabi 2019-2020 to study the impact of eco-friendly products on disease control in linseed. Among the different ecofriendly products tested NSKE 0.5% was found most effective in minimizing the severity of powdery mildew (20.22%) and significantly superior. The standard check wettable Sulphur was the next best treatment (27.92 %) followed by *Pseudomonas fluorescens* (5 g/l), *Bacillus subtilis*(5 g/l) and cow urine and were remain at par with each other in reducing the disease intensity over control (70.18%). Maximum seed yield 1460 kg/ha was obtained with Wettable Sulphur 0.3% followed by NSKE 0.5 % (1381 kg/ha) and cow urine 10 % (1164 kg/ha) and was remain at par with each other and significantly superior over rest of the treatments including control (996 kg/ha).The highest ICBR was recorded with NSKE 0.5 % i.e. 13.81 followed by Wettable Sulphur 10% (10.00). Negative ICBR recorded with Sour butter milk 10% (-0.29). Therefore it is concluded that application of NSKE 0.5 % resulted in reducing severity of powdery mildew in linseed.

SUPPLEMENTATION OF L-THREONINE IN STEP DOWN DIETARY CRUDE PROTEIN LEVELS OF COMMERCIAL BROILERS ON THE METABOLIZABILITY OF NUTRIENTS AND SERUM BIOCHEMICAL PARAMETERS

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The research study aimed to evaluate the effect of reduced dietary crude protein and supplementation of L-Threonine on Metabolizability of nutrients and serum biochemical parameters in commercial broiler diets. Four hundred and sixty broiler chicks were randomly assigned to 7 dietary treatments following completely randomized design, each treatment had six replications of 11 birds each. The control dietary formulation was prepared to meet requirement of nutrients and amino acids. The dietary Crude protein was reduced by 0.75, 1.50 and 2.25 per cent units. The treatments with reduced Crude protein level were supplied with synthetic L-Threonine to need desired level of Threonine as in control and all other amino acids were met as per the standard requirements by supplying the limiting amino acids. The treatment without L-threonine at reduced dietary crude protein levels was maintained as a negative control. The Dry matter Metabolizability, Organic matter Metabolizability, Crude Fiber Metabolizability and Ether Extract Metabolizability among all the treatment groups did not differ significantly. However, there was a significant ($p < 0.05$) decrease in the Crude Protein Metabolizability by step down of dietary Crude Protein levels without L-Threonine and L-Threonine supplementation significantly ($p < 0.05$) increased Crude Protein Metabolizability at all step down Crude Protein reduction levels of 0.75, 1.5 and 2.25 per cent units. The results of the effect of supplementation of the L-threonine by reducing the dietary crude protein at the end of the experiment on serum biochemical parameters viz total protein, albumin, globulin revealed no significant difference with data pertaining to serum total protein, albumin and globulin but the serum uric acid levels of 2.25 per cent unit reduced Crude Protein group with L-threonine supplementation group showed significant difference as compared to that of 0.75 per cent unit reduced CP without L-threonine supplemented group.

INFLUENCE OF L-TRYPTOPHAN IN LOWERED DIETARY CRUDE PROTEIN LEVELS OF COMMERCIAL BROILERS ON METABOLIZABILITY OF NUTRIENTS AND SERUM BIOCHEMICAL PARAMETERS

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The study aimed to evaluate the effect of reduced dietary crude protein and supplementation of L-Tryptophan on Metabolizability of nutrients and serum biochemical parameters in commercial broiler diets. A total of four hundred and sixty broiler chicks were randomly assigned to seven dietary treatments following completely randomized design, each treatment had six replications of eleven birds each. The control dietary formulation was prepared to meet requirement of nutrients and amino acids. The dietary Crude protein was reduced by 0.75, 1.50 and 2.25 per cent units. The treatments with reduced Crude protein level were supplied with synthetic L-Tryptophan to need desired level of Tryptophan as in control and all other amino acids were met as per the standard requirements by supplying the limiting amino acids. The treatment without L-Tryptophan at reduced dietary crude protein levels was maintained as a negative control. The Dry Matter Metabolizability, Organic matter Metabolizability, Crude Fibre Metabolizability and Ether Extract Metabolizability among all the treatment groups did not differ significantly but there was a significant ($p < 0.05$) decrease in the Crude Protein Metabolizability by step down of dietary CP levels without L-Tryptophan and L-Tryptophan supplementation significantly ($p < 0.05$) increased Crude Protein Metabolizability at all step down CP reduction levels of 0.75, 1.50 and 2.25 per cent units. The results of the effect of supplementation of the L-tryptophan on serum biochemical parameters viz total protein, albumin, globulin revealed no significant difference but the serum uric acid levels of various treatment groups differ significantly. 2.25 per cent unit reduced Crude Protein group with L-tryptophan supplementation group showed significant difference as compared to that of 0.75 per cent unit reduced without L-tryptophan supplemented group.

EVALUATION AND SUITABILITY OF WEED FLORA BIOMASS FOR VERMICOPOSTING IN JAMMU REGION

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A pot experiment was conducted for 2 years (two cycles) at Research Farm Chatha, SKUAST-Jammu to study evaluation and suitability of weed flora for vermicomposting. The experiment was laid out in Randomized Block Design with three replications. The 11 treatments were taken viz. *Cannabis sativa* + FYM, *Parthenium hysterophorus* + FYM, *Eichhornia crassipes* + FYM, *Lantana camara* + FYM, *Ageratum conyzoides* + FYM, *Cynodondactylon* + FYM, *Anagallis arvensis* + FYM, *Leucaena* + FYM, *Eichhornia crassipes* + *Anagallis arvensis* + FYM, FYM alone and Crop waste + FYM. It is found that the all weeds flora biomass mixed with FYM in 1:2 combinations significantly increased population of worms over alone application of farm yard manure (FYM). The maximum number of worm population (1797 no/m^3) was recorded under *Eichhornia crassipes* + FYM treatment followed by *Leucaena* + FYM (1738 no/m^3) during both the

cycle of study. The lowest worm population was recorded under alone application of FYM treatment (1327 no/m³). The NPK content in vermicompost also significantly influenced by weed flora biomass + FYM over FYM alone. The maximum N content of 2 cycle mean (2.42%) was recorded in *Leucaena* + FYM treatment while P content in *Lantana camarana* + FYM (0.97 %) and K in *Eichhornia crassipes* + FYM (1.92%). However during both the year of study found that all weed flora + FYM combinations taken more time to completion of cycle over FYM alone treatment. The mean data showed that the maximum production of vermicompost (58.23 kg/m³) was recorded in *Eichhornia crassipes* + FYM treatment whereas lowest in FYM alone treatment (53.07 kg/m³). Among the different weeds flora bio mass for vermicomposting *Eichhornia crassipes* + FYM (1:2) followed by *Leucaena* + FYM found most suitable weed flora for vermicompost.

Keywords: Vermicomposting, weed flora biomass, worms

CULTURAL, MORPHOLOGICAL AND PATHOGENIC VARIABILITY AMONG THE DIFFERENT ISOLATES OF *Fusarium oxysporum* f. sp. *ciceri*

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Chickpea (*Cicer arietinum* L.) is an important pulse crop, which belongs to family *Leguminaceae*, chickpea having 2n=16 number of chromosomes. Chickpea is native of India and tropical, subtropical and temperate regions. It is ranked 3rd after common bean. Pulses play an important role not only from economical point of view but also due to their nutritional value. Chickpea is valued for their nutritive seeds with high protein content, 25.3-28.9 per cent after dehulling. Carbohydrate 61.5 per cent, fat 4.5 per cent and vitamins 2.44 per cent. Variability among the ten isolates of *Fusarium oxysporum* f. sp. *ciceri*(FOC), collected from different locations of Parbhani district in Maharashtra. Ten isolates were studied in respect of cultural, morphological characters and Pathogenic variability. Result of the above study reveals that pathogenic variability has been established by inoculating ten days old seedlings of different cultivars individually with the *Fusarium oxysporum* f. sp. *ciceri* isolates. JG 62 exhibited susceptible reactions to FOC isolates with highest percentage of seedling mortality whereas, JG 315 and BCP-160 were exhibited resistant reactions to the FOC isolates with lowest mortality percentage due to wilt varied within the cultivars. Cultural studies of all isolates of *F. oxysporum* f. sp. *ciceri* resulted that isolates differ in the growth rate, types of colony, sporulation, and pigmentation on Potato Dextrose Agar is being favorable for luxuriant growth for all the isolates and dry weight of mycelia mat growing them on Potato Dextrose Broth medium. Morphological studies of different isolates of *Fusarium oxysporum* f. sp. *ciceri* concluded resulted in the variations in size, septation and formation of chlamydospores.

MORINGA THE SUPER FOOD AND ITS POLLINATION ECOLOGY

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Moringa oleifera commonly known as drumstick or moringa is a vegetable native to India. It's the miracle tree whose every part is nutrient packed. They are all great source of Vitamin C, protein, beta-carotene, iron and potassium, which is more packed form of supplements. The dried leaves had crude protein levels of 30.3% and 19 amino acids. This tree is referred to as a miracle tree due to its rich source of certain macro and micro nutrients of great importance in human nutrition. The chemical composition of the different parts of the Moringa tree may vary depending on cultivar and source. M. oleifera leaf, seed and flower have found numerous applications in food. Phytochemicals present included: tannins, steroids and triterpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugars. The local communities use M.oleifera leaves to treat common ailments. Presence of phytochemicals in the extracts, indicate possible preventive and curative property of M. oleifera leaves. The flower of moringa provides both nectar and pollen rewards to bees and getting pollination benefit with them. Honeybees and carpenter bees visited the flowers frequently, touching anthers and stigma. Stingless bees also forage pollen in Drumstick. Among hymenopterans Apis group includes three insects namely Apiscerana indica, A. dorsata, A. florea and Non Apis group includes ten insects. Moringa honey is precious natural product with benefits known throughout the world by its incomparable medicinal values. The products of moringa are sustainable remedy for malnutrition and will be highly suitable to combat hidden hunger during and after COVID-19 pandemic in India.

Keywords: moringa, pollinator, honey, nutrients

FIELD EFFICACY AND RESIDUES OF CHLORFENAPYR 10 SC IN CHILLI P. KARTHIK¹, PARAMASIVAM M², RAMYA M³, MURALITHARAN V⁴ AND KUTTALAM S⁵

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Studies were carried out at Tamil Nadu Agricultural University, Coimbatore during 2012-2013 to evaluate the bio-efficacy of chlorfenapyr 10 SC against Spodopteralitura (Fabricius) and Scirtothrips dorsalis (Hood) in chilli. On the basis of observations on the number of S.litura and S.dorsalis during first and second trial in 2012-2013, it was observed that chlorfenapyr 10 SC were the most effective. The doses of chlorfenapyr 10 SC @ 100,150 and 200 g a.i.ha⁻¹ were found more effective against S.litura and S. dorsalis during both seasons as compared to standard check (Fipronil 5 SC). The green chilli fruit yield was recorded higher in the treatments of chlorfenapyr 10 SC @ 100,150 and 200 g a.i.ha⁻¹ (22.9, 22.4 and 23.8 t ha⁻¹, respectively). Chilli plants sprayed with chlorfenapyr 10 SC even at 100, 200 and 400 g a.i.ha⁻¹ doses did not show any phytotoxic effects like epinasty, hyponasty, leaf injury, wilting, vein clearing and necrosis. Spiders and coccinellids population in chilli ecosystem showed considerable decrease initially in all the treatments, it started increasing in later. More than 85 per cent of the residues were dissipated on third day after spraying. The initial deposit of chlorfenapyr 10 SC @ 100 and 200 g a.i ha⁻¹ was 0.1958 and 0.3267 µg g⁻¹ respectively, which dissipated to below detectable level on 5th day after spraying in chilli fruit. Since, the chlorfenapyr 10 SC residues were found at below detectable levels on 5th day after application, five days could be suggested as waiting period for chilli.

Keywords: Chilli, Bioefficacy, Chlorfenapyr, Phytotoxicity, Safety, Residue

QUANTIFY THE MECHANIZATION INDEX OF ALL 9-AGRO-CLIMATIC ZONES OF UTTAR PRADESH

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In Uttar Pradesh, the cropping intensity was about 153 percent as per 2011 census. The small and marginal farmers community is dominated in UP. The average size holding per farmer was only 0.83 ha. The average size per marginal farmer was about 0.40 hectare. The net sown area of Uttar Pradesh was calculated i.e. 11 percent of total area of India, which is approximately 20 % of the total food grain yield of the nation and contributes more than about 41 million tonnes of total food grain. The main cereal crops in the state are rice, wheat, groundnut, sugarcane, rapeseed, vegetables, fruits, bajra, maize, jowar and barley. In Uttar Pradesh, during the year 2019, the farm power availability was 3.06 kilowatt per hectare. Although, the state should take more and more power farming in well timed and precisely to obtain agricultural work at minimum amount and obtaining highest use work efficiencies in pricey inputs and also to conserve available resources because it is highly populated. In Uttar Pradesh, the cropping intensity was about 153 percent as per 2011 census. For completion of timely farm operations, there is need to increase agricultural power acquirable from the present level of 3.06 kW per hectare to 4 kW per hectare by 2030. The marginal, small and medium range of farmers can also take the benefit of farm mechanization for the high capacity equipment in most of the agricultural operations in which custom hiring is required. It is very much important to identify the variables, which are having highly significance towards the mechanization, once the quantification of mechanization is done. By 2020 in Uttar Pradesh, it is hope that about 70 per cent of unit farm operations i.e. tillage, sowing/planting, irrigation and threshing for all main crops will be fully mechanized and other unit operations for various crops will be mechanized up to 24–29 per cent. As per the latest report sale of tractors was maximum in UP i.e. about 134719 tractors was sold in UP in 2018-19 and about 58 tractors were available per 1000 hectare of land area in 2018-19. The state is covered by four divisions i.e. Eastern (24 districts), Western (29 districts), Central (15 districts) and Bundelkhand (7 districts). In UP state have 75 districts, 327 tehsils, 822 blocks and 107452 villages at present. The Uttar Pradesh is covered by into 9-agro climatic zones, 1. Bhabar and Tarai Zone 2. Western Plain Zone 3. Mid Western Plain Zone 4. South Western Semi-Arid Zone 5. Central Zone 6. Bundelkhand Zone 7. North Eastern Plain Zone 8. Eastern Plain Zone 9. Vindhyan Zone.

PROSPECTS OF UNDERUTILIZED FRUITS AND VEGETABLES TO ALLEVIATE HIDDEN HUNGER IN INDIA

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Micronutrient deficiency also known as hidden hunger, refers to inadequate intake of crucial vitamins and minerals such as zinc, vitamin A and folate-needed for healthy mental and physical growth of children. India ranks 97 among 118 nations on the Hunger Index and 184 million Indians, including many children are undernourished. Micronutrient (vitamins and minerals) under nutrition is a serious problem in India since monotonous cereal-based Indian diets are qualitatively poor in

content and bioavailable vitamins and minerals. Among the micronutrient deficiencies, continuing high prevalence of anaemia among vulnerable segments of the population due to iron deficiency is one of the leading risk factors of disease burden in India. Hidden hunger of other micronutrients also compromise immunity, mental and physical performance and productivity. In this context, there is an urgent need to take up programme on genetic resources exploration, management, utilization and improvement of underutilized fruits and vegetable crops to ensure food and nutritional security for future. The climate and soil of India are favourable for the production of different underutilized fruits and vegetables. Thus, the government of India has been taking some steps towards highlighting the underutilized fruits and vegetables consumption. The possible reasons for the low utilization of underutilized fruits and vegetables, in spite of their recognized importance are due to lack of availability of planting material, lack of awareness on nutritional and medicinal importance and lack of information on production technique of these crops. Underutilized fruits and vegetables production will meet the shortage of per capita consumption availability there by solve the nutritional problems and at the same time it generates the employment opportunities and also increase the income of rural people and finally it could contribute the national economy.

Keywords: Hidden hunger, human nutrition, underutilized fruits, underutilized vegetables.

DEMOGRAPHY OF COLONIES OF ASIAN GIANT HONEYBEE, *Apis dorsata* FAB.

N. NAGARAJA

The giant honeybee, *Apis dorsata* is known to be a major honey producer in the southern states of India. These colonies are highly migratory and travel for long distances during dearth seasons. A study was conducted on the demography of *A. dorsata* colonies in respect of arrival and departure of swarms in its well congregated regions in and around Bengaluru, Karnataka. The observations revealed that, *A. dorsata* swarms arrived at its congregation area during June and July, expanded their numbers, and showed gradual desertion of their colonies from January to April. The number of colonies in test congregation areas was varied from 20 to 250. However, the deserted colonies always left the barren combs behind, suggesting that they had left in response to deteriorating resource quality. The observation clearly show that, *A. dorsata* colonies exhibit annual migratory pattern and is a strategy of colony survivability to overcome from fluctuation in availability of pollen and nectar source and also the pests and diseases.

Keywords: *Apis dorsata*, nest congregation, demography, colony migration

IDENTIFICATION OF ECONOMICALLY PREDOMINANT RABI CROP FOLLOWED BY PADDY IN MAHARASHTRA

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Rice – Fallow area is more the paddy grown attracts of Maharashtra especially in Vidarbha region, only lathyrus is broadcasted as utera crop in this region. Therefore, with the objective to identify economically predominant rabi crop grown after paddy this experiment was conducted at AICRP on Linseed and Mustard College of Agriculture, Nagpur during the rabi season of 2019-20. The three maturity groups of paddy i.e. early variety (Sindewahi-1), mid-late variety (PKV HMT) and late

variety (PDKV Tilak) are taken in factor A with three rabi crops in factor B i.e. Mustard (variety – NRCHB -01), Linseed (NL-260) and Lathyrus (Local) are tested in FRBD design with three replications. Among the different rabi crops linseed crop is observed in maximum yield and net returns, this is due to more yield and cost of produce. System yield and economic returns was significantly maximum in sowing of rabi crops after early paddy and between the rabi crops linseed has recorded maximum system yield and returns. Paddy Equivalent yield (Kg/ha), Production efficiency ($\text{kg ha}^{-1} \text{ days}^{-1}$) and Economic efficiency (Net returns Rs. day^{-1}) was significantly maximum in sowing of rabi crops after early paddy and linseed recorded maximum in it, this might be due to the more yield of linseed. Treatment combination of sowing of linseed crop after early paddy system has observed significantly maximum Equivalent yield (Kg ha^{-1}) followed by sowing of linseed crop after mid late paddy and mustard crop grown after early paddy. Economic efficiency (Net returns Rs. day^{-1}) was highest in interaction of sowing of linseed crop after early paddy followed by mustard crop grown after paddy, this might be due to the less amount of cost of cultivation in mustard. It is concluded that Linseed crop was found predominant rabi crop after paddy on economic return basis.

Keywords: Predominant rabi crop, Paddy, Linseed, Mustard, growth and yield

GROWTH, YIELD AND ECONOMICS OF LINSEED (*Linum usitatissimum* L.) INFLUENCE BY DIFFERENT GROWTH REGULATORS

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The profitable importance of linseed (*Linum usitatissimum* L.) has attracted Agronomist to increase its seed yield using various agronomical and breeding approaches. Plant growth regulators (PGRs) have a significant role in enhancing yield and its related traits in linseed. Hence, to find out effect of different growth regulators on growth, yield attributes, yield and economics of linseed, the present experiment was conducted under AICRP on Linseed, College of Agriculture, Nagpur during rabi season of 2019-20. Treatments of growth regulators includes 1.0 and 2.0 ppm Auxin, Gibberellic acid (GA) 200 and 400 ppm, 0.1 % Tebuconazole, 75 ppm salicylic acid and combination of 1.0 ppm Auxin + 200 ppm GA. Growth regulator shows significant effect on growth, yield attributes and yield of linseed. Growth and yield attributes was observed highest after application of 400 ppm GA and application of 0.1 % Tebuconazole which was at par with 1.0 ppm Auxin + 200 ppm GA and 75 ppm salicylic acid. The seed yield of linseed was recorded significantly higher in application of 400 ppm GA which was at par with application of 1.0 ppm Auxin + 200 ppm GA and spraying of 200 ppm GA and treatment having 75 ppm salicylic acid. The gross monetary return was found maximum in the application of 400 ppm GA, but net monetary return and B:C ratio resulted minimum due to the high market cost of GA (Rs. 9000/- for 400 ppm). Net monetary return and B:C ratio was found maximum in application of 75 ppm salicylic acid, this might be due to the low cost of Salicylic acid. Based on these findings, it is concluded foliar application of 75 ppm Salicylic acid as growth regulator lead to maximum yield and economic returns for enhancing productivity and profitability of Linseed.

Key Words: Linseed, Growth regulator, Gibberellic acid, Salicylic acid, growth and yield

YIELD POTENTIAL OF DIFFERENT GENOTYPES OF LINSEED INFLUENCED BY NUTRIENT LEVELS UNDER RAINFED CONDITION IN VIDARBHA REGION

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Nutrient management influences the production of linseed, therefore to find out yield potential of different genotypes of linseed the present experiment was conducted under AICRP on Linseed, College of Agriculture, Nagpur during Rabi Season of 2019-20 in Factorial Randomized Block Design with three replication. Three genotypes NL-356, JLS-95 and T-397 were tested with three nutrient levels 50 % RDF, 100% RDF and 150 % RDF. The result revealed that among the genotypes the yield potential of NL-356 was maximum and achieved 26% highest over JLS-95 and 13% over T-397 under rainfed condition of Vidarbha region. Different nutrient levels recorded maximum seed yield in the treatment 150 % RDF which was at par with the treatment 100 % RDF. The increase in nutrient level from 50 % RDF to 150 % RDF influence the growth and yield attributes which favours the increase in yield. However, increase yield in 150% RDF is only 0.8% than 100% RDF, whereas 100% RDF was recorded 23.6 % higher yield than 50% RDF. Highest seed yield (kg/ha) was recorded in the interaction of genotype NL-356 with RDF 150% (905 kg/ha) which was at par with 100% RDF in the same genotype NL-356 (895 kg/ha), but the net monetary return was recorded highest in the interaction of genotype NL-356 with RDF 100% (27587 Rs./ha). Therefore, it is concluded that genotype NL 356 has highest yield potential with 100 % RDF in rainfed area of Vidarbha region.

Keywords: Yield Potential, Nutrient level, Genotype, Linseed, Rainfed

ACTIVATION OF TLR9 EXPRESSION IN VECHUR AND CROSSBRED CATTLE BY BACTERIAL DNA

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Vechur a native breed of Kerala and highly disease resistant compared to other crossbred cattle. But systematic studies to understand the immune mechanism of disease resistance in Vechur cattle in comparison to that of crossbred cattle are scanty. Therefore, the present study was undertaken to study the immune response in terms of TLR9 expression in PBMCs isolated from Vechur cattle in comparison to that of crossbred cattle. PBMCs were isolated from blood collected from healthy Vechur and cross breed cattle and incubated with bacterial (*E. coli*) DNA. Total RNA was isolated and mRNA expression of TLR9 was studied. Incubation of PBMCs with bacterial DNA resulted in the expression of TLR9 in both, Vechur cattle and crossbred cattle. But, the level of expression of TLR9 was comparatively higher in Vechur cattle than crossbred cattle. Thus this study reports the inherent difference in the immune response of buffalo in comparison to that of crossbred cattle.

Keywords: Vechur cattle, immune response, TLR9, RT-PCR, Bacterial DNA, Immunotherapy

**EXPLOITATION OF GENERAL AND SPECIFIC COMBINING ABILITY OF OKRA
(*Abelmoschus esculentus* L.)**

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Okra is a traditional vegetable crop cultivated in tropical, subtropical and warm temperature. It is a perennial and available in two varieties green and red okra. The analysis of variance for combining ability studies in okra revealed that variances due to General combining ability (GCA) and Specific combining ability (SCA) were significant for all the yield attributing characters and yield growth suggesting the importance of both types of differences in the inheritance of the traits. Then the present study GCA and SCA also interacted significantly with the environments. The estimation of dominant characters deference was increase in magnitude and the studies of additive and non-additive gene action shows the majority of variance. The parents not revealed desirable GCA effects for all the traits simultaneously. The overall position of genotypes revealed that the parents VRO-3, VRO-4, VRO-5, VRO-6, Arka Anamika, Pusa A4 and Pusasawni exhibited significant desirable GCA effects for most of the traits. All of the crosses showed substantial desirable SCA effects for all the traits simultaneously. However, the crosses VRO-3 x Pusa A4; VRO-3 x Pusasawni; VRO-3 x Arka Anamika were found to be desirable for most of the traits.

Keywords: General combining ability, Specific combining ability.

MULCHING – AN EFFECTIVE MOISTURE CONSERVATION PRACTICE IN WATER DEFICIT AREAS

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Out of 2.7 % of fresh water availability on the earth, about 60 % water consuming only in agriculture sector. Rapid increase in world population, global warming and climate change and decreasing the natural resources were created tremendous pressure on limited water resources which leads to the severe decline the agricultural irrigation resources. Lower rainfall areas like arid and semi-arid regions of the world encountered serious problem because of inadequate precipitation and higher evaporation. Imbalance between rainfall and evaporation leads to the aiming to adopt soil moisture conservation practices especially those reduces the evaporation losses particularly in low rainfall areas. Mulching (Covering the soil surface to reduce the evaporation losses from the soil) with straw was extensively used management practice to conserve the moisture throughout the world. Mulch applied in such a way, that must cover the 70 % of the soil surface. Mulching reduced the evaporation by restricting the solar radiation on the soil surface. In recent years, with the improvement of the level of agricultural mechanization, especially combine harvester reaped the crop residue to leftover the soil, which can be effectively utilized for mulching in the coming season crop. Although, plastic mulch provided better yield but in many cases, straw mulch has been recommended because of its local availability and convenience in application. Mulching is an exclusive management practice for enhancing water use efficiency as well as weed control in the

crop fields. Mulches usually moderate the soil temperature by reducing atmospheric temperature fluctuations. Finally, it can be concluded that, practising of mulching can reduce the soil evaporation losses so that soil moisture can be conserved and utilized for higher water use efficiency of the crop.

Keywords: Mulching, straw mulch, water use efficiency.

INTEGRATED NUTRIENT MANAGEMENT STRATEGIES FOR INCREASING COTTON PRODUCTIVITY

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Cotton, a crop of both tropics and subtropics, is widely grown as a semi-xerophytic forced annual. Today, greater emphasis in cotton cultivation has been on the cost-cutting and low energy intensive farming/organic farming with very low biotic pressure to harvest the better produce since improved crop management especially its nutrition has a key role on both yield and quality. In addition, deterioration of the soil quality as a natural resource is also pertinent in the traditional cotton belt. Since high external input based cropping system has also degraded the soil-water system, depleted soil organic matter/carbon (SOM/SOC) stocks and fertility of soils, these have also led to associated secondary problems viz. salinization and water logging in some canal-irrigated tracts of the country. Consequently, imbalanced fertilization, soil erosion and exclusion of organic sources coupled with overuse of acid forming N fertilizers especially urea compels the crop/cropping systems to exploit soils reserves for other nutrients, thereby creating multiple nutrient deficiencies. Therefore, there is an urgent need for appropriate crop nutrition - a key component for higher yield realization and better quality - through integrated approach, called Integrated Nutrient Management (INM) or INM system for supplying crops the essential nutrients. The three main components of INMS as defined by FAO, 1998 are first, Maintain or enhance soil productivity through a balanced use of fertilizers combined with organic and biological sources of plant nutrients. Second, Improve the stock of plant nutrients in the soils and third and final, Improve the efficiency of plant nutrients, thus, limiting losses to the environment. Thus, integrated nutrient supply/management (INS) aims at maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired cotton productivity through optimization of benefit from all possible sources of plant nutrients in an integrated manner.

Keywords: Cotton, INM, Productivity.

EFFECT OF LONG TERM INTEGRATED NUTRIENT MANAGEMENT ON SOIL ORGANIC CARBON QUALITY

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The intensive cropping has been widely reported the decline in soil organic carbon (SOC) quality. It has been emerged from the various reports that integrated nutrient management (INM) can be one option to stabilize crop productivity. Nonetheless, limited data is available on the effect of INM on quality of SOC. For the study, soil samples were collected from selected treatments of the on-going long term fertilizer experiment, under maize-wheat system. The selected treatments viz., Unfertilized control, N (Recommended doses of N only), NPK (Recommended doses of N, P and K), 150% NPK (150% of recommended doses of N, P and K) and NPK+FYM (recommended NPK along with 5 t

farmyard manure/ha) were studied. The humic acids (HAs) were extracted by sodium hydroxide - sodium pyrophosphate mixture in N_2 environment. The total and carboxylic acidity of purified HA was quantified. Results indicated least total acidity under NPK+FYM ($412 \text{ cmol}(+) \text{ kg}^{-1}$), which is significantly lower compared with control, N and NPK. The spectroscopic analysis of extracted humic acid was done. The HA extracted from NPK+FYM had the highest E_4/E_6 ratio indicating least aromaticity as compared to control, N and NPK plots. The Fourier transformed infrared spectroscopy (FT-IR) of different HAs extracted from treatments showed all the representative bands of the functional groups commonly present in HA. The lower aromaticity and acidity of HA extracted from INM plots indicated a higher inflow of organic matter in those plots, often in excess of the assimilation capacity of soil microbes. Therefore, continuous application of FYM along with recommended NPK improved the C quality as indicated by lesser rates of humification.

MAINTAINING CROP NUTRIENT STATUS UNDER NATURAL FARMING

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In the green revolution era, the synthetic chemical fertilizers were used extensively to meet out the fertility requirement of various crops. However, with the passage of time, scientific surveys and evidences indicated a number of hazards associated with their overuse. There are reports of killing of various beneficial macro and micro organisms in the soil and contamination of soil, air, surface and ground water. There is eutrophication or hypertrophication of fresh water, meaning that bodies of fresh water become heavily enriched with minerals and nutrients due to runoff from land. This induces unwarranted growth of water plants and algae which can kill off marine animals, as well as overgrowth of Cyanobacteria that produces harmful toxins that can accumulate in the food chain and harm humans. The effects of chemical fertilizers on soil include: acidification, which limits the nutrient bioavailability, accumulation of toxic elements like, cadmium, fluoride, radioactive elements, lead, arsenic, chromium, and nickel and finally disruption of the biology of the soil. Direct contact with these chemicals can burn skin, damage the respiratory system, aggravate existing health conditions and increase the risk of developing certain diseases. People with existing kidney, liver, urinary or respiratory problems are particularly at high risk. To surmount the noxious effects of synthetic fertilizer based farming, a more sustainable farming system is much needed which could reduce the dependence on such expensive external inputs and simultaneously take care of their ill effects. Natural farming as suggested by Shri Subhash Palekar is a feasible and sustainable alternative. The idea is to let nature play a central role to the maximum extent possible. In natural farming, plant fertility status is maintained through application of natural inputs. The farmers meet out the fertility requirement of the crops with the help of natural products prepared easily by them on-farm from local cow based resources at almost negligible cost. Palekar has detailed the procedures of preparation and application of these man-made inputs. He has stressed on the use of ghanjeevamrita and jeevamrita for meeting the nutrient requirement of the crops.

Keywords: natural farming, ghanjeevamrit, jeevamrit

ASSESSMENT OF IMPACT LOW COST FILTER MATERIAL FOR ROOFTOP RAINWATER HARVESTING STRUCTURE

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Groundwater is declining at a very fast rate in the Muzaffarpur district and its vicinity areas. Water is essential and most importance resource for survival of all living thing on the earth planet. Our country India has only 2.4% land, 4% water, and 18 % share of world population. Freshwater is the lifeblood of the biosphere and the backbone of socio-economic development of a country (Fader et. al., 2013; Kumar, et. al., 2005; Rockström et. al., 2013; Silva et. al., 2013). Day by day water demand is increasing of the different sectors such as drinking, industry, agriculture and its quality and quantity decreasing. In the Muzaffarpur district many village panchayat facing water crisis problems due to decreasing of groundwater level.

Rooftop Rainwater Harvesting (RRWH) is the technique through which rainwater is captured from the roof catchments and stored in reservoirs. Harvested rainwater can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the household needs through storage in tanks. The Main Objective of this study is design of low cost filter material for Rooftop Rainwater Harvesting Structure. In this filter used three technology and seven replications for design the filter (T1) Boulder 2 meter: 0.5-meter stone: 0.5 Sand, (T2) Boulder 1.0 meter: 1-meter stone: 0.50 sand fill with plastic bottle: 0.5 Sand, and (T3) Boulder 1.5 meter: 1 meter stone: 0.5 charcoal: 0.5 Sand. Performance of the filter found as per as per low cost and passing the rainwater to groundwater (T2). The lowest increase was recorded in the around the study area, In Muzaffarpur, the level increased to 20.10 feet in 2020 from 22 feet during monsoon season. The study revealed that the adoption of this technique at mass level could help in getting the significant results. This would be possible only with the help of people participation.

Keywords: Filter, roof top Rainwater Harvesting, Artificial Groundwater Recharge.

KINSHIP: FLORA AND AVIFAUNA

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Birds interact with organism by many more ways and it's not an observation of nowadays it has been observed earlier. Most birds from urban parks depending on specific plant community due to specific dietary and nesting habit and requirement. These present days, most of the locust attacks on crop that is happened due to break down the food chain and birds kept in the cage. By keeping all things these in mind, we are trying to investigate the significance of ornamental plants as bird's food plants as well as why they love those specific plants (flora) and many more things through this study. Threats include, increasing poaching for feathers and meat, habitat destruction, mortality due to chemical fertilizers and pesticides, poisoning by farmers to prevent crop damage and extraction of various parts of flora for traditional medicines. To keep maintaining of kinship (loving relationship) between flora (ornamental plants) and avifauna (birds) plays an important role in regulating the ecosystem balance. So, the proper implication of conservation measures is the need of hour before extinction.

Keywords: flora, fauna, conservation, ecosystem

EFFECT OF SOIL APPLIED PACLOBUTRAZOL ON VEGETATIVE GROWTH, FLOWERING, FRUIT SET AND FRUIT YIELD OF LITCHI(*Litchi chinensis*Sonn.) CV. ROSE SCENTED

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The litchi (*Litchi chinensis*Sonn.) is the most renowned subtropical evergreen fruit, famous for its deliciously flavored, excellent quality and attractive red colour. Paclobutrazol (PBZ) is a cell elongation and internode extension inhibitor that retards plant growth by inhibition of gibberellins biosynthesis. It is a triazole derivative, also known as cultar (PP 333) and is effectively used for controlling vegetative growth which promotes the flowering as well as fruiting in various fruit crops including litchi. The effect of paclobutrazol at varying time intervals of litchi as soil drench application (1.00-4.00 g a.i. per meter canopy diameter) on vegetative growth of litchi (*Litchi chinensis*Sonn.) was investigated during 2016-18 in Pantnagar condition. The vegetative growth was significantly reduced due to higher dose of paclobutrazol (2.0-4.0 g a.i./meter canopy diameter). Application of paclobutrazol at the rate 2.0, 3.0 a.i./tree through soil application method was noted to be more efficient in reducing Panicle Length, Panicle width and advanced the date of panicle emergence. Soil applied paclobutrazole @ 2.0, 3.0 a.i./tree increased the male The results of first year experiment shows the minimum panicle length (21.41 cm) was found under treatment P₂ (40 ml/tree) followed by P₃ (21.58 cm), while the maximum panicle length was under control (25.32 cm). The application of paclobutrazol @ 40 ml/tree, the shoot length of litchi tree was found to be minimum (16.79 cm) as compared to control (19.60 cm). At varying time intervals, in the month of October estimated the minimum shoot length (17.72 cm) followed by September, while the maximum shoot length was noted under November (18.16 cm). The main purpose of this study is to focus upon contemporary information about paclobutrazol in litchi growth.

Keywords: Paclobutrazol; Panicle Length; Panicle width, Male flower; vegetative flush

RAISED-BED PLANTING: MAXIMIZING WATER USE EFFICIENCY

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An improved surface irrigation technique is offering farmers a practical and more sustainable alternative to conventional irrigation systems which tend to be highly inefficient and waste already-scarce water resources. Raised-bed planting – where crops are planted on ridges and irrigation water may be applied to bottom of furrows is a priority of the ‘Enhancing Food Security in Arab Countries’ initiative, an ICARDA-managed program getting to improve wheat production across nine Arab countries. Instead of spreading water over the entire surface area – the practice most commonly applied by farmers – raised-bed planting collects water more efficiently, applying this precious resource where it is most needed. Its introduction in Egypt and Sudan is not only improving water use efficiency – the amount of crop generated per m³ of water – but raising yields and boosting farmer incomes. Instead of spreading water over the whole area – the practice most commonly applied by farmers raised-bed planting collects water more efficiently, applying this precious resource where it's most needed. Its introduction in Egypt

and Sudan isn't only improving water use efficiency the quantity of crop generated per m³ of water by raising yields and boosting farmer incomes. Raising yields while improving water-use efficiency. The results, obtained during the initiative's first phase, compared the raised-bed technique with conventional flat surface irrigation.

- A 25 percent average saving in applied irrigation water
- A 30 percent average increase in grain yield
- mean 73 percent increase in water use efficiency
- A 30-50 percent saving within the quantity of seed used for planting.

In addition, raised-bed planting brought savings in energy and labor. the typical time needed to pump water to irrigate one hectare (ha) of wheat planted on a raised bed was 29.4 hours, compared to 43.9 hours on a flat field. the next reduction within the costs of labor and fuel – approximately 33 percent – contributed to an increase in farmer incomes.

Keyword: Raised bed planting, water use efficiency.

EFFECT OF SUPPLEMENTATION OF PHYTASE ENZYME ON PERFORMANCE OF COMMERCIAL BROILERS

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An experiment was conducted to study the effect of supplementation of phytase on performance of commercial broilers up to 6 weeks age. Four hundred day old Cobb broiler chicks were divided into five different dietary treatments T1, T2, T3, T4 and T5, respectively with four replicates, each having twenty birds per replicate. Treatment group T1 was control, T2 was fed with phytase enzyme with @ 250 FTU / kg of feed, T3 was fed with phytase enzyme with @ 500 FTU / kg of feed, T4 was fed with phytase enzyme with @ 750 FTU / kg of feed and T5 was fed with phytase enzyme with @ 1000 FTU / kg of feed. Feed formulation was done as per BIS 2007 specifications. Weekly body weight, feed intake, feed conversion ratio, serum calcium (Ca), phosphorus (P), bone minerals such as calcium (Ca) and phosphorus (P) were recorded. The data were analyzed by one way ANOVA using Statistical Package for Social Sciences (SPSS), 15th version and comparison of means was done by Duncan's multiple range test (Duncan, 1955) at p<0.05. The results showed that high doses of phytase (at 1000 FTU/kg) improved the feed intake, body weight gain, blood P levels and bone minerals such as Ca and P. From the present study overall it may be concluded that super dosing of phytase enzyme increased the better utilization of nutrients thereby increased body weight, better FCR leading to performance equivalent to the control group. It may be recommended that super dosing of phytase enzyme at dose rate of 1000 FTU/ Kg of feed is more beneficial from birds performance and profitability than the normal standard dose (at 500 FTU/kg) of phytase in the diet of commercial broiler chicken.

Keywords : Broiler, FCR, nutrient utilization, phosphorus, phytase, bone mineral

EFFECT OF SUPPLEMENTATION OF MORINGA OLIFERA LEAF MEAL (MOLM) AS A PROTEIN REPLACEMENT TO SOYABEAN MEAL ON PERFORMANCE OF COMMERCIAL BROILERS

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Abstract: A six week experiment was carried out to investigate the effects of supplementing Moringa oleifera leaf meal, as a protein replacement for soyabean meal in commercial broiler production. Five different graded levels of Moringa oleifera meal were used in formulating the diets. Feed formulation was done by using soyabean meal, maize and Moringa oleifera leaf meal for broiler starter (23% Crude Protein) and broiler finisher (20% Crude Protein). Two hundred Fifty day old vencobb chicks were randomly allocated to the five treatment diets T1 (0% Moringa oleifera leaf meal), T2 (25% Moringa oleifera leaf meal), T3 (50% Moringa oleifera leaf meal), T4 (75% Moringa oleifera leaf meal) and T5 (100% Moringa oleifera leaf meal) in a completely randomized design. Birds were reared under the deep litter system with five replicates for each treatment with ten birds per replicate for a period of 6 weeks. Weekly body weight, feed intake and feed conversion ratio were recorded throughout the period. Two birds from each replicate were slaughtered and various carcass characteristics were done after 6 weeks and the different body parts were weighed and recorded. Proximate analysis of Moringa oleifera leaf meal, broiler starter and broiler finisher diets were done and the results were tabulated. The data were analyzed by one way ANOVA using Statistical Package for Social Sciences (SPSS), 15th version and comparison of means was done by Duncan's multiple range test (Duncan, 1955) at $p < 0.05$. No significant differences were noted in the amount of feed taken by broiler birds under different treatments of Moringa oleifera leaf meal, however significant differences in feed conversion ratios were noted. It was therefore concluded that inclusion of Moringa oleifera leaf meal as protein replacement for soya bean meal in broiler diets at 25% inclusion level produces broilers of similar weight and growth rate compared to those fed under commercial feeds.

Keywords: Moringa oleifera leaf meal, broilers, protein, soyabean meal, feed conversion ratio

EFFECT OF RIPENING AGENT IN DIFFERENT CONCENTRATIONS ON RIPENING OF BANANA

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Ripening is the final stage in the life cycle of a fruit and it is an irreversible process. During ripening fruit undergoes various physiological and biochemical changes. These changes include conversion of sugar from one form to another, textural changes, colour changes, change in aroma and flavor. Banana is one of the most easily available climacteric fruit which is distributed throughout the world. Since it is a climacteric fruit, its commercial ripening can be carried out in storage houses to obtain good flavor, proper texture and uniform peel colour. Ethylene glycol, ethrel and ethephon are some of the most widely used and easily available ripening agents in the market. Banana fruits were treated with different concentrations of each of the above mentioned ripening agents. Different parameters like flavour, colour and time taken for ripening were studied and the results indicated that the treated fruits were more uniformly ripened than the untreated fruits. The treated fruits took less time to ripen than untreated fruits. No significant difference in taste, flavor and sweetness was observed in treated and non-treated fruits. This artificial method of ripening can be useful for small scale farmers and traders as it assures good quality and takes less time for ripening.

Keywords: Physiological, biochemical, climacteric

CLIMATE SMART AGRICULTURE AND SUSTAINABLE INTENSIFICATION: AN APPROACH TOWARDS MITIGATING FOOD INSECURITY

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Climate change disrupts food markets, posing population-wide risks to the food supply. Climate smart agriculture (CSA) proposes an alternative 'climate-wise' framework to foreground the inherently political dimensions of food and agriculture in an era of climatic change. With its emphasis on improving risk management, information flows and local institutions to support adaptive capacity, CSA provides the foundations for incentivizing and enabling intensification. Researches in East Africa have revealed that Banana-coffee intercropping in elevated temperature regions; multiple cropping, crop rotation, agroforestry, carbon sequestration, agriculture allied sectors, etc., can contribute to mitigation and storing an additional carbon per ha in the soil. The sustainable intensification (SI) of livestock production systems could contribute enormously to both adaptation and mitigation. The use of stone bunds can lead to nutritional benefits, while also allowing farmers to cope with changing weather (adaptation to wetter or drier climates). Soil fertility is often improved as a result of more manure being applied, and increased tree cover contributes further mitigation benefits. Thus, these techniques are climate smart form of sustainable intensification. There are increasing possibilities for low-income countries to orientate production along pathways that are both more sustainable and more productive to mitigate food insecurity. The assessment of technology preferences is based on farmers' current level of understanding about the benefits and costs of individual CSA technology. Farmers prefer some risk mitigation technologies such as crop insurance, agro-advisories and rainwater harvesting that can be supported by the government. Therefore, farmers' preferences for CSA technologies may differ based on their expectations of financial support from the government and other agencies. Similarly, their preferences may differ based on the combination of CSA technologies and their potential benefits for adaptation to climate change. There is a need for these issues to be further explored.

Keywords: climate smart agriculture, food security, sustainable intensification, climate change

BREEDING FOR ZINC DEFICIENCY TOLERANCE IN RICE

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Rice is the major staple food for more than half of the world population and 90% of it is being produced and consumed in Asia. Most of the world's rice is cultivated and consumed in Asia, which constitutes more than half of the global population. Zinc (Zn) deficiency is the third most limiting nutrient constraints after nitrogen and phosphorous especially in rice. It appears to be the most widespread micronutrient deficiency in crop plants resulting in severe yield losses and nutritional quality. Deficiency of rice to zinc has emerged with the intensive cropping of high yielding varieties which threatens to sustaining high levels of food crop production. Severe Zn deficiency in rice causes chlorosis, decrease in, or tillering, slower rate of crop maturity, and increased spikelet sterility. In lowland rice producing areas, Zn deficiency is associated with calcareous soils and is accentuated by prolonged flooding. Zn deficiency symptoms are more common on young or

middle-aged leaves. The most noticeable symptom is the plant's loss of turgidity, where the plant falls over and floats on the surface of the water. Some possible ways to break the yield plateau under these kinds of abiotic stresses are increasing area under production along with good crop management or by developing tolerant varieties with enhanced genetic tolerance to get a required output level. The need to identifying allelic sources for Zn tolerance and their introgression into elite varieties are more important to get the desired yield potential even in Zn deficient soil. A novel approach in plant breeding for tolerance to abiotic stresses is to identify the genomic reasons associated with tolerance and further utilization to develop tolerant line through modern biotechnological and molecular tool with appreciable yield performance.

Keywords: Rice. Zinc, deficiency, abiotic, stresses

SEASONAL INCIDENCE AND ECO-FRIENDLY MANAGEMENT OF BRINJAL SHOOT AND FRUIT BORER, (*Leucinodesorbonalis*GUENEE) THROUGH BIO-PESTICIDES

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Investigations were carried out on eco-friendly management of brinjal shoot and fruit borer, *Leucinodesorbonalis*Guenee through bio-pesticides at the Experimental, Organic Research farm kargunwa ji Jhansi, Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University Jhansi (Uttar Pradesh) during Rabi season of 2019-2020. During the course of investigation, brinjal shoot and fruit borer, *Leucinodesorbonalis*Guenee the major pest found infesting. *Bacillus thuringiensis*, *Beauveria bassiana* recorded minimum shoot infestation, *Metarhiziumanisopliae* resulted in minimum fruit infestation on number as well as minimum percentage shoot infestation. It can be concluded that maximum control of brinjal shoot and fruit borer, provided through the bio-pesticides followed by two sprays at recommended interval and doses of *Bacillus thuringiensis* (Bt) 2.0 kg/ha, Neem oil @ 0.5 %, *B.t* @ 0.5 %, NSKE @ 0.5 %, has found effective and economic for the control of brinjal shoot and fruit borer, *L. orbonalis* G. The seasonal population of *Leucinodesorbonalis* G. is greatly influenced by abiotic factors and peak population levels are observed. Significantly the data showed that the population of *L. orbonalis* G appeared on 23rd November and continued till last week of 7th February. The pest population declined and recorded minimum thereafter and varied from 3.24 to 5.64 larvae/plant. During this period mean temperature and relative humidity ranged from 4.2 to 24.1 and 55.0 to 91 per-cent, respectively. The management of brinjal seasonal incidence of (*Leucinodesorbonalis* G).under bundelkhand region should therefore be promoted and tailored from november onwards using an integrated approach.

Keywords : Brinjal, *Leucinodesorbonalis*, biopesticides, seasonal incidence, weather parameter,

DIFFERENTIAL RESPONSE OF SOME COWPEA GENOTYPES TO DIFFERENT ZINC SUPPLY REGIMES

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A sand culture experiment and also a separate pot experiments were conducted to study the differential response of cowpea genotypes to different zinc supply regimes. Nine different cowpea genotypes were raised in sand culture with two treatments (with Zn and without Zn) to study the effect of Zn application on root parameters, Zn concentration and uptake in shoot and roots. A soil culture experiment was also conducted using twelve cowpea genotypes receiving three treatments namely, no application of Zn, soil application of 2.5 mg Zn kg⁻¹soil and conjoint use of soil application of 2.5 mg Zn kg⁻¹soil + foliar application of Zn. In sand culture pot experiment, the highest average total root length (944.9 cm), surface area (227.4 cm²), diameter (0.75 mm) and root volume (0.71 cm³) were recorded in V1. The highest average number of root tips was observed in V11 (1676.1). The highest average number of forks (7085.0) and number of crossings (1194.8) was noted in V10. The highest average cation exchange capacity of roots (0.398 meq g⁻¹) and the highest average Zn concentration in shoots (83.8 mg kg⁻¹) was recorded in V5. Zinc application increased the average root length, surface area, root volume and number of forks but decreased the average root cation exchange capacity. The interaction effect of genotypes and Zn levels significantly influenced only root cation exchange capacity. The highest average shoot weight per plant (0.92 g), ratios of Zn concentration and uptake in shoot and roots, Zn uptake in shoot and total Zn uptake were recorded in V6. The highest mean root weight per plant (0.190 g) was recorded in V10. The highest average zinc concentration in shoot and Zn uptake in roots were noted in V5. The highest average Zn concentration in roots was recorded in V3. Zinc application had favourable effect on these parameters except root dry weight. Based on Zinc efficiency index (ZEI) of shoot dry matter the genotype V3, V5, V6, V9 and V10 indicated tolerance to Zn deficiency. In soil culture experiment, genotypic differences were noted in plant height, thousand seed weight, seed and straw yield beside the differences in the concentration of micronutrient cations, P in seed and straw and also phytic acid and protein concentration in seeds. Soil application of 2.5 mg Zn kg⁻¹ soil and conjoint use of soil application of 2.5 mg Zn kg⁻¹ soil + foliar application of Zn increased the average plant height, thousand seed test weight, seed yield, straw yield and Zn concentration in seed and straw significantly over no application of Zn. Soil application of Zn and conjoint use of Zn through soil and foliar application had significant influence on Zn and Mn concentration and uptake of micronutrients cations in seeds and straw of all cowpea genotypes. A significant effect of Zn supply regimes was also noted on P concentration in straw, P uptake in seed and straw, phytic acid and protein concentration in seed. The interaction effect of genotypes and Zn supply regimes influenced the yields, the concentration and uptake of micronutrient cations by cowpea and also the concentration of phytic acid and protein in cowpea seeds. Zinc efficiency indices calculated based on soil application of Zn, genotypes V5, V6, V8 and V9 were tolerant to Zn deficiency and further based on conjoint use of soil + foliar application of Zn, genotypes V3, V8 and V9 appeared to be tolerant. Genotype V2 behaved as the most susceptible genotype under both Zn supply regimes. These tolerant genotypes need to be used for sustainable pulse production and breeding program.

EVALUATION ON FRONT LINE DEMONSTRATIONS ON pigeonpea [(*cajanuscajan*(L.) Millsp.)] CROP IN SARAN DISTRICT, BIHAR

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The front line demonstrations (FLD) programme on pigeonpea crop were conducted during 2011-12 and 2012-13 in Saran District, Bihar. The farmer's field were selected from different village (0.4ha) from the district. These demonstrations focused on increased productivity and replacement of old variety with promising high yielding improved variety Narendra Arhar -1 (NDA-1) and get the feedback from farmers on the performance of pigeonpea variety. The study revealed that over years, NDA-1 variety was superior over traditional farmer's practices. The economic influence of pigeonpea observed i.e. net return (Rs. 41066), Benefit cost ratio (4.10:1), extension gap (4.56 q/ha), and technology index (17.80%). By conduction of front line demonstration (FLDs) on farmer's field there was significant increase in knowledge level of the farmers and majority of farmer's showed high level of satisfaction about demonstrated technologies.

Keywords: Front line demonstration, NDA-1, Technology index, Extension gap, B:C ratio

INTEGRATED WEED MANAGEMENT IN SUNFLOWER(*Helianthus annus L.*)

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An experiment on Integrated weed management in Sunflower (*Helianthus annus L.*) was conducted at TCA Dholi, farm, under RPCAU, Pusa, Bihar during Spring 2014-2016. The experiment comprised in RBD design with ten treatments. The soil of the experimental plot was alkaline in reaction (pH 8.3), medium in organic carbon and low in available N, P₂O₅, K₂O, S and Zn. Weed control treatments recorded significantly lower weed count and weed dry weight and produced higher seed yield than weedy check. Among the weed control treatments weed free plot recorded lowest weed count and weed dry weight but was found at par with pre-emergence application pendimethalin @ 0.75 kg/ha followed by one inter cultivation at 20 DAS + one hand weeding at 40 DAS and significantly lower over rest of the weed control treatments. Higher Weed control treatments recorded significantly lower weed count and weed dry weight and produced higher seed yield than weedy check. Among the weed control treatments weed free plot recorded lowest weed count and weed dry weight but was found at par with pre-emergence application pendimethalin @ 0.75 kg/ha followed by one inter cultivation at 20 DAS + one hand weeding at 40 DAS and significantly lower over rest of the weed control treatments. Higher weed control efficiency and lower weed index were also associated with weed free plot followed by pre-emergence application of pendimethalin @ 0.75 kg/ha followed by one inter-cultivation at 20 DAS and one hand weeding at 40 DAS. Among the weed control treatments, weed free plot recorded highest seed yield but was found at par with pre-emergence application of pendimethalin @ 0.75 kg/ha + one inter cultivation at 20 DAS followed by one hand weeding at 40 DAS, pre-emergence application of pendimethalin @ 1 kg/ha followed by post emergence application of propaquizofop @ 62 gm/ha at 20 DAS and pre-emergence application of pendimethalin @ 1.0 kg/ha followed by post-emergence application of quizalofop ethyl @ 37.5 g/ha at 20 DAS and significantly higher over rest of weed control treatment. Similar trend was found in net return also. However, higher B:C ratio was recorded under pendimethalin @ 1.0 kg/ha pre-emergence + propaquizofop @ 62 g/ha at 20 DAS

which was found at par with pendimethalin @ 1.0 kg/ha pre-emergence + quizalofop ethyl @ 37.5 g/ha at 20 DAS and pendimethalin @ 1.0 kg/ha as pre-emergence + fenoxoprop ethyl @ 37.5 g/ha and significantly higher over rest of the weed control treatments.

Keywords: Integrated weed management, Sunflower, effective, economical

HI-TECH HORTICULTURE, HORTICULTURAL INNOVATIONS, FOOD PROCESSING AND VALUE ADDITION

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Horticulture forms an integral part of food security and nutrition. It is an essential component of stakeholder's economic security. Hi-tech horticulture is a technology which is modern, less environment-dependent and capitalintensive but with a capacity to improve productivity and farmer's income. In the new era of changing climate, hi-tech horticulture has become necessity to sustain the productivity and economic stability of the Indian farmers. Hi-tech horticulture is useful not only for production of fruits, vegetables and flowers but also for conservation, plant protection, post-harvest management including value-addition. The technologies encapsulated in hi-tech horticulture include use of genetically modified (GM) crop varieties derived from biotechnology and genetic engineering, micro-propagation, integrated nutrient, water, weed and pest management, protected cultivation, organic farming, use of modern immuno-diagnostic techniques for quick detection of viral diseases, post-harvest technologies, including cold chain. Although we are the leading producer of fruits and vegetables in the world, but are still lagging behind at the export front due to non-availability of adequate technology to meet the international standards. To make our produce competitive globally is the utmost need since our country is a potential foreign exchange earner in horticultural produce. The irony is that we do not lack in production but in processing. Only 2% of horticultural produce is processed as compared to the world where more than 50% produce is processed. Hi-tech horticulture is a powerful tool for doubling productivity of horticultural crops and can be used for doubling farmer's income. Intensive cultivation in hi-tech protected environments with hi-tech production inputs is the necessity of the day. Further processing and value addition can also generate broad economic aspects such as increased government revenues to food, infrastructure, health and nutrition intervention programmes.

Keywords: Hi-Tech Horticulture, Food Processing, Value Addition

INNOVATIVE APPROACHES IN SOIL HEALTH, LAND RESOURCES AND LAND USE PLANNING AND MANAGEMENT

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Deterioration in soil health now-a-days is major concern which is influencing agricultural sustainability. This decline is due to poor land management practices which are being adopted by farmer's for getting more production from land. These practices involve continuous use of chemical fertilizers, pesticides etc. which are leading to the poor soil health. We have to move towards some innovative approaches for improvement in soil health, land use planning and management in collaboration with available land resources. Farming which involve use of available land resources and avoid use of chemicals as much as possible should be adopted. For an instance adopt organic farming instead of conventional farming and other options may include mixed farming, dairy

farming, precision farming. Adoption of crop rotation according to the land capability, use organic manures like FYM, vermicompost, green manuring etc and also the type of tillage should be decided. Application of microbial inoculants is also best approach as their interaction in soil-plant ecosystem enhance nutrient uptake from the soil and also from the fertilizers and their interaction reduce the toxic effect of synthetic fertilizers thus improve the soil health. We have to focus on some operational approaches like decide which crop and crop variety should be selected according to the growing season, available resources and land management practices, and when to till, sow, plant, fertilize and harvest the crop. If land is not suitable for arable farming then go for horticulture and silviculture approach or in combination of both according to climatic situation. Land use planning should be such that it involve maximum use of all available resources and reduce cost of production and thus also enhance farmer's income.

Keywords: Precision farming, Land use planning, Soil health, Organic farming, Crop rotation

GREEN TECHNOLOGIES FOR SUSTAINABILITY

MAYANK

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Green tech or green technology is an umbrella term that describes the use of technology and science to create products that are more environmentally friendly. It is a type of technology that is considered environmentally friendly based on its production process or its supply chain. Green tech—can also refer to clean energy production; clean energy production is the use of alternative fuels and technologies that are less harmful to the environment than fossil fuels. The goal of green tech is to protect the environment and in some cases, to even repair past damage done to the environment. It includes, the technology infrastructure used to recycle waste, purify water, create clean energy, and conserve natural resources. Although the market for green technology is a relatively young, it has garnered a significant amount of investor interest due to increasing awareness about the impacts of climate change and the depletion of natural resources. In the present scenario, green technologies are playing significant role in changing the course of nation's economic growth towards sustainability and providing an alternative socio-economic model that will enable present and future generations to live in a clean and healthy environment. Green technology, refers to the development and extension of processes, practices, and applications that improve or replace the existing technologies facilitating society to meet their own needs while substantially decreasing the impact of human on the planet, and reducing environmental risks and ecological scarcities. The concepts of Green Technologies, if endorsed and pervaded into the lives of all societies, will facilitate the aim of the Millennium Development Goals of keeping the environment intact and improve it for the civilization to survive.

Keywords : eco-friendly, sustainability, clean technology, natural resources

EFFECT OF BIO-STIMULANTS ON PHYSIOLOGICAL PERFORMANCE IN COWPEA

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The present investigation was carried out during the summer season of 2019 in cowpea genotype (CS-88). The physiological parameters in cowpea plant like water relation, gaseous exchange studies, chlorophyll stability index, chlorophyll content (SPAD units) and photochemical quantum yield showed declining trend in rainfed condition. But with the imposition of different biostimulants at flower initiation stage, values of physiological parameters found to be increased. Values ranged from control to biostimulant application in osmotic potential (-MPa) (-1.24 to -1.09), RWC (%) (72.7 - 88.7), assimilation rate ($23.31 - 29.73 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$), transpiration rate ($1.70 - 2.07 \text{ mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$) and stomatal conductance ($0.02 - 0.03 \text{ mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$). Similarly, chlorophyll content (SPAD units) and photochemical quantum yield also showed the increasing trend after foliar application of different biostimulants and the values varied from (41.0 - 51.4) and (0.678 - 0.718), respectively. Reversibly, relative stress injury was found to be decreased from control (35.51) to biostimulants application (20.58) in cowpea under moisture stress. Osmolytes enhanced under moisture stress and further increased rapidly after imposition of different biostimulants at flower initiation stage. The value of biochemical parameters ranges from proline ($131.4 - 381.9 \mu\text{g g}^{-1} \text{ DW}$) and glycine betaine ($144.0 - 424.2 \mu\text{mol g}^{-1} \text{ DW}$) over their respective control. Conclusively, based on the above studies it could be concluded that after foliar spray of different biostimulants under rainfed condition, cowpea performed better by maintaining higher plant water status, photosynthetic rate and lower values of RSI (%).

Keywords: Biostimulants, moisture stress, Cowpea

PRECISION AGRICULTURE AND IMPACT OF CLIMATIC CHANGE ON BIODIVERSITY

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Precision agriculture is a technology that can be used to improve profitability while reducing the impact of agriculture on environment. Precision agriculture is an approach to management that uses information technology (IT) to ensure that the crops and soil receive exactly what they need for optimum health and productivity. The goal of PA is to ensure profitability, sustainability and protection of the environment. It is based on use of information and science based decision tools to improve productivity and profitability. The core ideas behind precision agriculture consist of improved decisions, higher yields, and reduced agricultural impacts. Precision agriculture requires technologies like GPS (Global positioning system) GIS (Geographic information systems), auto steer, yield monitors and variable rate fertilizer. Assessing the impacts of climate change will be a vital task in developed as well as developing countries because of interdependent physical, biological, and chemical processes are ongoing in earth and human system. Biodiversity is the variation at genetics, species and ecosystem level and climate change has the detrimental impact on it as it is well known. The effects includes changes in growing season of crops, phenology, primary production and species distribution of different crop species. It has resulted in the increased

mortality of coral reefs. Decline in number of polar bears due to rapid melting of ice caps and disruption in pollination due to decline in pollinator population. Climate change is also going to result in frequent drought occurrence, unstable food availability, decreased in water supply. Practicing mitigation by reducing emission of greenhouse gases from sources, by substitution and conservation of energy, improving carbon sequestration etc. Practicing potential adaptation measures (e.g. reducing the impacts of climate change), support to natural resources & protected areas contribute to protection of biological resource.

Keywords: Agricultural impact, biodiversity, adoption measures

ORGANIC FARMING WITH RESIDUE FREE PRODUCTION

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Residue free farming can be phrased as the use of organically derived biocides and bio fertilizers to protect the crops and augment their growth. By adopting modern day agri-technologies like greenhouses, drip irrigation system, fertigation, IFM, IPM, residue free production, rain water harvesting, high density plantation, contour farming, waste land utilization, etc., it becomes relatively easy to maintain the quality of the produce and also add to the nutritional value to the same. In order to meet the expected standards of the consumers, it is necessary to integrate the process of residue free farming. An important element in the process of growing the produce is the lack of use of chemical fertilizers and use of natural fertilizers. This one change itself accounts for a big difference in the residue content of the product and takes it a notch further in making it residue free. The extensive abuse of chemical fertilizers has led to a change in the health of the soil leading to the depletion of the nutritional value of the product and thus creating a hazardous impact on the consumers of the product. Due to rapid evolution and increased awareness in the health segment, people are now focused on the benefits of consumption of fresh and residue free food. To support this change, it is necessary to adopt the practice of residue free farming where in the food that is produced is pure, fresh, healthy and nutritious. This produce is grown in an eco-friendly way and without use of any hazardous chemical fertilizers, to benefit the end consumer in the best possible way.

Keywords: residue-free, chemical fertilizers, nutrition, health, consumer

SEED VIGOUR AND VIABILITY: TESTING, TECHNOLOGY AND ENHANCEMENT

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Ordinarily seeds are tested for germination and viability by laboratories equipped and staffed to determine the quality of seed. Quality seed offers better field emergence and stronger plant growth. Some kind of plants produces hard seeds that are considered to be viable although they do not germinate when tested. Sometimes dormant seeds (which can't germinate even in favourable condition) also find during testing procedure, for such seeds there is requirement of special procedures. Proff. Lakon (1940) were invented tetrazolium test. A viability test aims to detect quickly all live seed whether they are dormant or not. There were number of test were conducted for testing viability. Seed vigour another important parameter of seed quality. The best known procedure is cold test for corn and subsequently developed for a few other crop species. Other test

were also performed for vigour test i.e. GADA test, Brick gravel test etc. Each of these tests has been useful for specific kind of seeds but has not proved reliable for a wide range of various species of seeds. After testing, we practices to enhance these parameter by priming, coating, pelleting etc. Seed pelleting means adding inert material to increase size of seed and confirms precision sowing for example: onion, carrot, lettuce. Different chemicals like vitavax, bavistin were used as seed treatment which reduce the soil borne pathogen but may also improve germination. Physical enhancement methods are seed coating i.e. chemicals, film coating/ temp. Sensitive polymers, micro-organisms/ rhizobium. Different coating like acrylic, cellulosic polymerase and mercurial etc. were used. Different priming are done in which Hydropriming is common for enhancement of germination value. Biopriming involves biological micro-organisms like *B.subtilis*, *Trichodermavirida* etc. Pre germinated seed another concept in which re-inducing of desiccation tolerance in seed after selecting germination stage so that they can be packaged and distributed. When planted, they germinate rapidly and uniformly.

Keywords; Seed vigour, viability, quality seed, coating, pelleting, Tetrazolium test, seed treatment, hydropriming, osmopriming, halopriming, biopriming, micro-organisms, correlation.

STUDY OF IMPORTANT INSECT-PESTS AND MANAGEMENT OF WHITEFLY ON BLACK GRAM

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Pulses are an important group of crops which provide high quality protein, complementing cereal proteins for pre-dominantly vegetarian population of the country. Pulses are the rich source of protein, improves soil fertility and physical structure of the soil. Globally pulses are cultivated over an area of 82.382 million hectares, with average production and productivity of 81.8 million tones and 993 kg/ha, respectively. In India pulses occupies an area of 29.99 million hectares, with average production and productivity of 25.23 million tones and 841 kg/ha, respectively. Chickpea, pigeon pea, black gram, green gram and soybean are major pulses, of which black gram (*Vigna mungo* (L.) Hepper) is the third important crop and occupies an area of 5.44 million hectares (*Kharif* and *Rabi*) with average production and productivity of 3.56 million tones at a productivity level of 655 kg/ha, respectively. . Average productivity of black gram in India is less as compared to world's average. Insect-pests damage is one among the other factor limiting the production of this crop. It is attacked by 40 to 60 insect species at different stages of crop growth Among these insects, whitefly, *B. tabaci* appears as a major pest of *kharif* black gram, besides mung bean and soybean and cause damage by sucking the cell sap from the leaves, honeydew release that lead to sooty mould formation, as a vector of Urdbean leaf crinkle virus and yellow mosaic disease. Under severe infestation condition yield losses to the extent of 100% have been reported in *Vigna* species due to whitefly. Keeping in view the importance of the crop, study had been undertaken to evaluate the available germplasm, population dynamics and whitefly management.

**BIOLOGY OF SHOOT FLY (*Atherigonavarsoccata*Rond) ON THE HOST, SORGHUM
(*Sorghum bicolor* L. Moench)**

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Different studies on life cycle of *Atherigonavarsoccata*Rond has been identified as it is a serious sorghum pest in India. The life cycle consists of four stages, where the average period (and range) of the embryonic, larval and pupal stages was 3.5, 13.0 and 10.4 days, respectively. The females laid 20-25 eggs each at a rate of 1-2 day, the eggs were white colored cigar shaped, usually laid on the lower surface of the leaves, parallel to the midrib. The larvae enters the stem and feed at the rising point by cutting the central shoot at its root, triggering the symptom referred to as 'dead heart'. Four larval instars were observed and it was observed that the larvae were cannibalistic only inside the host, sorghum. The first larvae do not migrate from one plant to another, but the third instar may do so if the food source is exhausted. Pupation took place inside the stem, or sometimes in the soil, and the pupal stage lasted for 810 days. In each seedling, only one pupa was produced. Adults lived 3-4 days without food and 12-14 days without a 10% glucose solution.

Keywords: Biology, Dead heart, Life cycle

**PRECISION AGRICULTURE, SOIL AND WATER CONSERVATION FOR
SUSTAINABLE AGRICULTURAL PRODUCTION**

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Agriculture is an integral part of food security and nutrition. World population is expected to approach 9.7 billion by 2050 and we are aggravating the natural resources due to intensive agricultural productions. Agriculture is both part of the problem and part of the solution to threatening of natural resources. Precision Agriculture is one such solution in which we can conserve soil and water for sustainable agricultural system. Precision farming comprises a range of technologies that combine sensors, information systems, improved machinery and informed management to maximize production by taking into account variability and uncertainty within agricultural systems. It provides a way of controlling the food supply chain sustainably and regulating both the quantity and quality of the agricultural products. High-precision agriculture can mitigate unnecessary input residue accumulation or migration, can save money, and can prevent interactions that would reduce yields. It has significances beyond input quantity. It includes proper positioning in the soil or in the plant, it includes timing of input, it includes relationships with other inputs to establish sufficient balance, it includes proper levelling, drainage and contouring of the soil, and more. High precision has or can have positive environmental consequences, directly and indirectly. High-precision agriculture will allow the production of the required food and fiber on much less soil and water than is currently used. It is a method that gives maximum economic returns. Now is the time to sustainably escalate agricultural production and reducing the negative impressions of agriculture like wastage of soil, water and others. Robust policies which integrate food security and sustainability must be implemented nationally and globally.

IMPROVEMENT OF MINERAL CONTENT IN PEARL MILLET

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Micronutrient deficiency also termed as hidden hunger affects more than two billion people worldwide (FAO 2015). Micronutrient malnutrition, resulting from dietary deficiency of Iron (Fe) and Zinc (Zn), is a widespread food related health problems especially in developing countries. Deficiency of Fe in diet leads to anemia (Gregory *et al.*, 2017), and also causes stunted growth, low birth weight and delayed mental development etc. (Singha *et al.*, 2018). Similarly, deficiency of Zn in the diet can have symptoms of hypogonadism, dwarfism and mortality during childhood. There are several approaches to overcome malnutrition *viz.*, industrial food fortification, dietary diversification and bio fortification. Crop bio fortification is of special significance for predominately agriculture based societies such as India. Pearl millet is a major source of dietary energy and nutritional security for a vast population in arid and semi arid regions of Asia and Africa. It is also cheapest source of micronutrients compared to cereals and vegetables (Rao *et al.*, 2018). It is a richer source of protein, fat, iron, calcium, magnesium, phosphorus and total carotenoids than some of the other important cereals (Singh *et al.*, 1999). So, efforts should be made to identify superior and higher in mineral content sources and utilizing them in breeding programme.

Keywords: Malnutrition, Micronutrient deficiency, Crop bio fortification, Nutritional security, Mineral content

CLIMATE CHANGE AND GLOBAL WARMING: IMPACTS, POLICIES, PLANNING AND MANAGEMENT

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Agriculture's dilemma in the 21st century involves a holistic convergence of development's cultural, social and economic foundations to fulfil the needs of present generations, without compromising future generations' livelihoods. Climate change entails both global warming driven by human greenhouse gas pollution and the consequent large-scale weather changes. The implications of the climate change on the atmosphere are large and far-reaching. Extremely wet or dry events increased in India and East Asia during the Monsoon season. Global change's long term consequences include further melting of the glaciers, ocean heat, sea level rise, and water acidification. Carbon dioxide is steadily dissolved by the ocean, thereby increasing water acidification for hundreds to thousands of years. Coastal habitats are under threat since almost half of the wetlands disappearing as a result of climate change and other human impacts. Policies and initiatives includes improved use of clean energies and hybrid heat and power plants, improved energy quality of homes & factories, reduced CO₂ emissions from new passenger cars, landfill pollution control initiatives. Planning for climate change involves addressing future climate change, mainly by lowering greenhouse gas emission, responding to current and expected environmental changes, and implementing steps to minimize catastrophic risk. The approaches to climate change risk management mainly fall into four broad categories: 1) mitigation — efforts to reduce emissions; 2) adaptation — increasing the capacity of society to cope with climate change; 3) geoengineering or climate engineering; and 4) expansion of knowledge base — efforts to learn and know more about the global climate.

Keywords: Climate change, Global Warming, Greenhouse gases.

A STUDY ON EFFECTIVE NON-CHEMICAL WEED MANAGEMENT TECHNIQUES FOR DIRECT SEEDED RICE

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A field experiment was conducted during the *kharif* season of 2018 at the experimental farm of Agronomy, NU:SASRD, Medziphema campus, Nagaland, to study the effect of non-chemical weed management techniques for direct seeded rice. The experiment was laid out in randomized block design with 8 treatment combinations consisting of non chemical weed management practices comprised of five treatments *viz.* Weedy check (W_1), Hand weeding at 30 and 60 DAS (W_2), Soil solarisation (W_3), Brown manuring (W_4), Organic mulching (W_5). Sowing methods comprised of three treatments *viz.* Broadcasting (S_1), Line sowing at 20 cm (S_2) and Hand dibbling (S_3). Non-chemical weed management treatment hand weeding at 30 and 60 DAS significantly reduced weed density, weed biomass and increased weed control efficiency, grain yield (35.05 q ha^{-1}), stover yield (80.93 q ha^{-1}) whereas weedy check (W_1) recorded the highest weed density, weed biomass and lowest weed control efficiency, grain yield (17.30 q ha^{-1}), stover yield (69.77 q ha^{-1}). Among the sowing methods S_2 -Line sowing recorded lower weed density, weed biomass and higher weed control efficiency, highest grain yield (29.24 q ha^{-1}).

Keywords: Weedy check, Soil solarisation, Brown manuring, Organic mulching

MORPHO-PHYSIOLOGICAL RESPONSES OF RAINFED UPLAND RICE (*Oryza sativa* L.) TO WATER STRESS CONDITIONS

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Water stress or Moisture stress is one of the deleterious constraints that adversely affect the rainfed upland rice productivity. Constraints which reduce the productivity of upland rice are late sowing, heavy weed infestation, poor soil fertility and poor adaptation of improved upland cultivars. Direct seeded rainfed upland rice fields are scattered and sowing time varies considerably from first week of March to second week of May. The major causes of unsuitability of upland rice are due to low and erratic rainfall pattern, soil texture and sloping or undulating terrain. Water stress in rice plant affects plant growth, grain filling, yield and development of crops. Water stress affects the leaf area, relative leaf water content, plant height, panicle length, number of grains per panicle, test weight of 1000 grains. Water stress also responses chlorophyll content, transpiration, photosynthesis, stomatal conductance, membrane stability and abscisic acid content. Tolerant plants have adapted themselves by deep root system, leaf rolling, hormonal signaling, and efficient transpiration. Upland rice varieties constitute significant genetic variations with respect to their morphological and physiological traits which enable them to escape, tolerate or resist and recover from water stress.

Keywords: water stress, relative leaf water content, root system, chlorophyll, transpiration, photosynthesis.

CURRENT STATUS OF BIOPESTICIDES IN INDIA: A REVIEW

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Most important threat in agriculture is numerous pests such as bacteria, fungi, weeds and insects, which lead to reduction in yield and poor quality of the produce. Since 1960s, intensive use of synthetic pesticides is the most commonly used method for pest control. The first used synthetic pesticide was in 1940s namely dichloro-diphenyl-trichloroethane (DDT), followed by the use of organophosphate and carbamate pesticides. After that with the help of Green Revolution technology crop production, the food production in developing countries has increased through the intensive use of inputs like chemical fertilizers and pesticides. The use of agricultural chemicals helps a lot in increasing agricultural productivity; at the same time they have caused numerous environmental problems such as they deteriorate the soil health, water quality and produce quality. Many other problems like development of insect resistance, genetic variation in plants and toxic residues in food and feed. Moreover the intensive use of synthetic pesticides causes many other ill-effects such as pesticide resistance, pest resurgence, outbreak of secondary pests, pesticide residues in the produce, water, soil and air. By considering all the above mentioned problems, there is a need to develop alternatives for these synthetic agro-inputs. Therefore, the use of bio-pesticides seems to be the only solution to overcome these problems because of their diverse mode of action and pest control ability. As they avoid the development of resistance in the pests. In a country like India with huge diversity of plants, there is an urgent need of identifying new bio-pesticides which can serve the purpose of pest control. There is a need to develop its own bio-control agents (BCA) as it will be cost effective and also environment friendly.

Keywords: Bio-pesticides, Bio-control Agent, Synthetic pesticides, Green Revolution

DOUBLING THE FARMERS INCOME BY DUAL PURPOSE MAIZE PRODUCTION

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Field experiment was conducted during *rabi* season of 2016-17 at the Assam Agricultural University. The experiment was laid out in factorial RBD. The treatment consisted of eight crop management practices viz., Grain crop at 60 cm x 30cm (T₁), Fodder crop at 30 cm x 15 cm (T₂), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at knee-high stage for fodder (T₃), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at tasseling stage for fodder (T₄), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at milking stage for fodder (T₅), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at knee-high stage for fodder (T₆), Fodder cum grain crop (30 cm x 15 cm) removal of alternate row at tasseling stage for fodder (T₇), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at milking stage for fodder (T₈) and two levels of fertilizer viz., F₁: 100% of RDF and F₂: 150% of RDF. The highest grain yield being 34.21 q ha⁻¹ and was produced from T₁ which was *at par* with crop management practice T₆, T₇ and T₈. However, green fodder yield (164.04 q ha⁻¹) and crude protein yield (3.11 q ha⁻¹) was found to be highest in crop management practice T₂. Among the fertilizer levels F₂: 150% of RDF recorded the highest, grain yield, green fodder. In terms of economics, crop management practice T₇ recorded the highest gross return (Rs 1,

20,951.67 ha⁻¹) and crop management practice T₁ recorded the highest net return (Rs 90,631.40 ha⁻¹) followed by crop management practice T₇ (Rs 83,333.24 ha⁻¹). Among the fertilizer level F₂: 150% of RDF recorded highest gross return (Rs 1,05,543.92 ha⁻¹) net return (Rs 70,650.40 ha⁻¹).

Keywords: Fodder, tasseling, milking.

WATER MANAGEMENT STRATEGIES IN RICE FIELDS FOR MITIGATION OF GREENHOUSE GASES

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Rice soils under wetland condition produce methane gas due to anaerobic decomposition of organic matter. Soil redox potential and soil pH are considered critical control factors for emission of this greenhouse gas. Moreover, rice soils exhibit limited oxygen supply in the plough layer during the growing season as a result of standing water over the field. Mild anaerobic condition favors nitrous oxide emission during denitrification and this gas is further reduced to dinitrogen under strong anaerobic conditions of flooded rice soils. This chapter deals in mitigation of emission of these greenhouse gases through adoption of different water management practices. Midseason drainage during flowering period with shortened draining time (3 days) is recommended to maintain high rice yield and low emission of methane and nitrous oxide. Soil water potential of -30 kPa can be a potential option for maintaining rice yield, increasing water use efficiency and reducing methane emission without any significant change in global warming potential from direct seeded rice fields. Regulation of soil redox potential decreases the total methane emission up to 36% compared to continuous flooding. In addition to this, rice grain yield under soil redox potential regulated condition remains equal to or higher than that of continuous flooding. Modified System of Rice Intensification (transplanting 18 days old seedlings) method is found to be an effective and efficient technology over System of Rice Intensification (transplanting 12 days old seedlings) method in terms of mitigation of methane and nitrous oxide emission, yield, water saving and also overcomes the problem of transplanting tender seedlings.

Keywords: Global warming potential, Midseason drainage, Modified System of Rice Intensification

INTERNET OF THINGS (IOT) BASED INSECT PEST DETECTION AND MANAGEMENT

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About 70% of the population in India depends upon farming and one third of the nation's capital comes from farming. Currently, it is found that, all over the world, around 50% of the farm produce never reach the end consumer due to wastage. A major role has been known to be played by the insect pest and diseases that reduces the yield drastically. The insect pests hamper the health of the plant, reduce the biomass and hence, productivity and production. However, this requires

continuous monitoring of experts which might be extremely expensive in large farms. Further, in some developing countries, farmers face many hurdles even in reaching the experts, thus making the process too expensive and time consuming. Therefore, in today's modern era, automatic detection and recognition of insect pest is the need of the hour to automatically detect the symptoms caused by a particular insect pest as soon as they appear on plant parts. This benefits in monitoring large fields of crops and helps to treat the insect pests of plants in its early stages of attack. This chapter strives to focus mainly on the information regarding different sensors used and IOT based techniques using automated tools for an accurate insect pest detection and management.

Keywords: IOT, sensors, insect pests, detection and management.

LOTUS: A SUSTAINABLE TEXTILE FIBRE

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Nowadays, the demands for environment-friendly and fully biodegradable sustainable materials have substantially increased due to people's consciousness of environment. Natural fibres play a big role towards sustainable environmental friendly future. In this direction lotus is the one of the sustainable fiber. Lotus fibre is a kind of natural fibre which is usually extracted from the lotus stem and the lotus root. Currently, a considerable amount of lotus stems are left in the pond to be wasted after the blossom season or the harvest of lotus roots. These residues could provide abundant natural cellulose resources which can be used in the textile, paper, medical and construction industries. The lotus fibre consists of cellulose, hemicellulose, fat, lignin, ash, pectin, amino acid. Where, cellulose is the main ingredient which shows similarity with cotton fibers. The lotus fiber has length of 40-150 mm, average fineness of 18-22 dtex, average breaking strength of 1.50-1.58 cN/dtex, and elongation at break of 5.72-5.80 %. The lotus fiber and its product is cool, crispy, ventilate, comfortable and healthy. These fabrics are 100 percent organic, and hence are environmentally friendly. By wearing lotus fibre fabrics, one can feel calm, peaceful and meditative. The aim of this study is to focus on the extraction, properties, spinning, popular brands, and end uses of the lotus fibre.

Keywords: Sustainable, Lotus fibre, Cellulose, Organic, Extraction.

THE ROLE OF ORGANIC FARMING IN AGRICULTURAL SUSTAINABILITY

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Agriculture is the true driving force of an economy. Role of agriculture in the development of an economy is inevitable. Agriculture plays a vital role in Indian economy and it has been practiced for centuries. With the increase in population and to achieve self-sufficiency in food production India adopted green revolution. Green revolution has led to gradual decline of soil health and environment. In order to counteract this crisis, emphasis on sustainable agriculture is the need of the hour. One way of promoting sustainable agriculture is organic farming. Sustainable agriculture is the farming system that focuses on producing food in a way that does not degrade the environment and contributes to the livelihood of the communities. It is the act of farming using the principles of ecology. In organic farming compost, manure, organic wastes, rotation of crops are used. Organic

farming is a system of production that avoids the use of synthetically produced fertilizers, pesticides, growth regulators, genetically modified organism and livestock additives. Organic farming focuses on the welfare of human without harming the natural environment. It is an eco-friendly farming system which follows the principle of health, ecology, fairness and care for human beings as well as for soil. This method can sustain and increase farm productivity by improving the soil health and overall improvement of agro-ecosystem. Organic farming practices result in numerous benefits. It can reduce the risk of human, animal and environmental exposure to toxic materials.

Keywords: Organic, farming, economy, compost, manure.

SMART AGRICULTURE

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Agriculture sector is always counted in priority list for each country but without modernization in this sector no one will be able to meet the food demand of a global population expected to reach 9.7 billion by 2050 and 10 billion by end of this century. India, which has 70% population living in rural areas with Agriculture as the main stay of employment, is setting up goals to improve the condition of farmers by targeting to double the Agriculture income by the year 2022. The only solution to these problems is smart agriculture over the traditional method of cultivation. Smart agriculture involves integration of advanced technologies like IoT, Big-data, artificial intelligence into already persisting agricultural practices with a view to boost production quality as well as quantity. It helps to generate the data for further analysis to provide the operator with accurate information for better decision making to gain high quality output. The goal of smart agriculture is to ground decision making support system for farm management. We need to know how some smart applications like remote sensing, GIS, drone based agriculture, climate smart agriculture will lead us to achieve precision agriculture.

Keywords: IoT, smart agriculture, GIS, Big-data

THERMODYNAMIC PARAMETERS (ΔG^0 , ΔH^0 , ΔS^0) OF CADMIUM SORPTION IN SLUDGE TREATED CALCAREOUS SOILS AT TWO DIFFERENT TEMPERATURE

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Laboratory investigations were carried out to study thermodynamic parameters (ΔG^0 , ΔH^0 , ΔS^0) of cadmium sorption in calcareous soils. Ten soils varying in clay, organic carbon and CaCO_3 content were used for sorption study. Each soil was treated with sewage sludge @ 25 and 50 g kg^{-1} and incubated for 30 days at $25 \pm 2^\circ\text{C}$ giving four wetting and drying cycles. These untreated and treated soils were used for Cd sorption. The Cd sorption was determined by equilibrating 2g of soils with 20 ml of CdCl_2 solution containing 5 to 750 $\mu\text{mol Cd}^{2+} \text{L}^{-1}$ at 20 ± 2 and $40 \pm 2^\circ\text{C}$. The ionic strength of the solution was kept constant with background electrolyte, KNO_3 containing ambient concentration of 0.01 mol L^{-1} . The sorption was calculated by depletion of Cd concentration in equilibrium solution. The Cd sorption data were fitted into different equations and the

thermodynamic parameters were calculated on the basis of sorption data. The thermodynamic parameters indicate that retention of Cd by soils is governed by spontaneous reaction as the value of ΔG^0 is negative for both untreated and treated soils. The spontaneity of the reaction of Cd^{2+} with soils increased with rise in temperature. The value of ΔH^0 are positive and negative indicating both exothermic and endothermic reactions are operating in retention of Cd by soils. The value of ΔS^0 decreased progressively with enrichment of soils with sludge at different levels. This may be due to decrease in randomness of the system as Cd^{2+} present in the solution phase shifted to adsorption phase.

Keywords: Cadmium, sewage sludge, sorption, free-energy change (ΔG^0), enthalpy change (ΔH^0), entropy change (ΔS^0)

A DETAILED INSIGHT INTO THE BIOLOGICAL CONTROL POTENTIAL OF AN APHID PARASITOID, *Diaeretiellarapae* USING GREEN PEACH APHID, *Myzuspersicae* AS HOST

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Biological and behavioural attributes of *Diaeretiellarapae* (McIntosh) (Hymenoptera: Braconidae) were studied on *Myzuspersicae* (Sulzer) (Hemiptera: Aphididae). The total developmental duration of the parasitoid was longer in younger nymphal instars compared to that in older nymphal instars of aphid. Host age affected the oviposition period and fecundity of the ovipositing parasitoid. Survival of the immatures was higher in older as compared to the younger instars. Sex ratio for the parasitoid was found to be female-biased. Adult longevity of *D. rapae* was longer for females compared to that of males. Mean longevity of adult female parasitoid was longer, while parasitizing nymphs of younger age groups (1-2 days) compared to that of older age groups (4-5 days). *M. persicae* reared on capsicum (*Capsicum annum*) was found to be the best host for *D. rapae* based on high percentage of parasitism, high fecundity and female-biased sex ratio. The parasitoid showed a higher preference towards second nymphal instar of *M. persicae* both in choice and no-choice tests. The results from experiments on mutual interference revealed that per capita searching efficiency decreased significantly from 0.91 to 0.07 with an increase in parasitoid densities from 1 to 8. Logistic regression exhibited a type II functional response for the parasitoid, *D. rapae*. The handling time (T_h) and searching efficiency (a) values were calculated to be $1.59 \pm 0.17\text{h}$ and $0.037963 \pm 0.005029\text{h}$, respectively. This investigation suggests that *D. rapae* could be an effective biocontrol agent of *M. persicae* under laboratory conditions and would supplement its biological control in oilseed brassicas.

Keywords: biological control, *Diaeretiellarapae*, India, *Myzuspersicae*, rapeseed-mustard

CROP PROTECTION: ROLE OF PLANT BREEDING AND BIOTECHNOLOGY

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Plant Breeding and biotechnology has played major role in imparting resistance to insect-pests and pathogens. It is the most economical and eco-friendly strategy among all available sources of disease and pest management. There are several reports of successful incorporation of resistance genes into cultivated plants from related sources. Biotechnology has helped to overcome hybridization barriers in gene transfer and genes identified in microbes can now be incorporated in cultivated plants with the help of recombinant D.N.A technology. A successful example is Bt cotton which has increased the yield of Cotton several fold, however, there are various concerns regarding transgenic crops on their environmental effects and allergenicity to humans and animals. The recent advances in the field of genomics and molecular biology has elucidated several key genes, enzymes, proteins and molecular pathways which can be utilized through biotechnology in crop improvement programmes. Biotechnology can provide novel materials which has to go through selection cycles in a breeding programme for ultimate realization of benefit to farmers. Moreover, characterization of resistant genotypes in the available diverse germplasm and its usage in breeding programme has resulted in several high yielding resistant cultivars and seems to be a common and highly successful practice in the backdrop of concerns regarding transgenic crops.

Innovative Approach in Agricultural and Allied Sciences

THE ROLE OF EXTENSION WORKER IN AGRICULTURAL TECHNOLOGY TRANSFER IRSHAD HUSSAIN

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Technology transfer is actually a learning process used to describe the process of formally transferring new agricultural findings, improved practices or innovations that may result from research institutions into the agricultural sector. The extension workers role is to teach the farmers about how to use new technologies and its application in the agricultural sector. The extension workers help a lot in determining the needs constraints, priorities and opportunities for farmers. They also helps in teaching farmers the value of improved agriculture, recommending suitable crops, encouraging adopting of appropriate technologies, and evaluating farmers' reaction and attitudes toward development goals. Extension workers are also support in encouraging farmers in involvement in project identification, planning, implementation, and evaluation as well as support viable development projects. Extension workers should develop relationship for harmonious functioning. The conditions are that the influential persons in the village who may be either farmers or non-farmers who wield influence and may encourage or impede the extension workers role in the extension activity. An extension worker with creditability and technical competence and specialization in human interaction could become an insider rather than an outsider thus playing the role of a teacher, an advisor and a leader and would organize the farmers into a dynamic group playing his role effectively. Extension is a two way traffic between the farmers and research organizations in which the extension worker takes to the farmers what is new for them and which is beneficial in boosting their income and thus raising their economic and social well-being and also taking the problems faced by the farming community to the laboratories where the researchers would be studying those problems and after finding out the solution would send back the answer to farmers through the extension worker.

Keywords : Extension worker, Technology Transfer.

CURATIVE POTENTIAL OF PRIMARY AND SECONDARY PLANT METABOLITES AGAINST CORONAVIRUS SPECIAL EMPHASIS ON SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS 2 (SARS-COV-2)

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Compared with the primary metabolic plant products such as carbohydrate, lipids, amino acids, nucleic acid etc. there are several secondary metabolite products also characterised in plants. The compound which are essential for plant growth referred as primary metabolite, besides those compound not required for normal growth and development by metabolic pathways common to all plants are referred as secondary plant product or secondary metabolite also known as natural products which are essential for plant defences toward pest, pathogen and herbivore. Medicinal plants are the species of plants possess certain biochemical compound effective against to different pest, pathogen and diseases. Herbal medicine is still the mainstay of about 75-80% of the world population, mainly in the developing countries. An alkaloid is a nitrogenous organic molecule that has a pharmacological effect on humans and animals. Well over 2000 alkaloid have been isolated till now and their structure determined. So many alkaloid used for treat different viral and bacterial lung and heart diseases such as Influenza, Pneumonia, Cough, Fever, Fatigue, Nausea etc. Well known alkaloid like D(-)-Ephedrine used to treat hay fever, brochial asthma/COPD, Lobeline, Nicotine are used as respiratory stimulant, similarly Camphor acts a expectorant. The plant alkaloids also effective against SARS-CoV-2 virus in terms of DNA adducts, antiviral effect, immune buster, cough expectorant, reducing fever, respiratory stimulant etc. The medicinal plants species such as *Forsythiaefructus*, *Licorice*, *Chrysanthemiflos*, *Rhizomafagopyricymosi*, *Broussonetiapapyrifera* contain possible anti SARS-CoV candidate drugs. Epigallocatechin gallate, epicatechingallate and galocatechin-3-gallate are the anti SARS-CoV-2 natural compound common in green tea (*Camellia sinensis*). Plant contain millions of bioactive compounds needs to be structural identification, toxicology, synthesis and Clinical trials.

Keywords: Alkaloid, Medicinal plants, Antiviral, Corona virus, anti SARS-CoV-2, Secondary metabolite, SARS, MERS, M^{pro} and PL^{pro}, S protein, ACE-2, Spike protein, *in silico*

EFFICACY EVALUATION OF FUNGICIDES FOR CONTROLLING *Fusarium* WILT IN LENTIL GROWN IN MEGHALAYA

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Fusarium is an important soil borne fungus which is devastating to crops particularly to pulse crops like lentil. Since it can survive in soil for long periods and perpetuate as chlamydospores, its threat remains from one season to another. Availability of chemical control measures in the form of effective fungicides is a simple and efficient way for controlling the wilt disease caused by *Fusarium*. In the present study the efficiency of three fungicides namely Bavistin (Carbendazim 50% WP), Ridomil Gold (Metalaxyl MZ + Mancozeb 64% WP) and Saaf (Carbendazim 12%+ Mancozeb 63% WP) were tested to control *Fusarium* wilt in lentil plants grown in pot experimentin

completely randomized design (CRD) consisting of three treatments and three replications. The results indicated that out of the three treatments, Ridomil Gold was found to be most effective in controlling the disease as the lentil plants depicted less mortality, good vigour and growth of seedlings in this treatment. Saaf was found as next best chemical in controlling the *Fusarium* wilt followed by Bavistin. A dose of 0.2% Ridomil Gold for foliar spray + 0.5% for soil drenching to be applied once per week was found to be most effective in controlling the wilt disease under Meghalaya soil conditions.

Key Words: Fusarium, chemical control, Ridomil Gold, Meghalaya

POPULARISATION OF TECHNOLOGY FOR ACID SOIL MANAGEMENT IN MAIZE UNDER JHUMFIELDS OF ZUNHEBOTO DISTRICT

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Maize (*Zea mays* L.) is an important crop in the world with its adaptability towards varied agro-climatic conditions. It is also known as the queen of the cereals and ranks third among the cereals next to wheat and rice. The leading producer of maize is USA with 10.34 t ha⁻¹ followed by Argentina (5.61 t ha⁻¹) and China (5.35 t ha⁻¹). It is the third most important cereal next to rice and wheat contributing about 10% of the total food grain production. Maize is the second most important crop next to rice in the Northeast region of India grown under rainfed upland soils. It is use for direct consumption as well as feeds to the farm animals. The area and productivity of maize in Nagaland is 68910 hectare and 1.98 Mt/ha and hence its production needs to be improved. The soils of this region is acidic in reaction which needs to be reclaimed for increase productivity of the maize. Therefore a field level demonstrations on acid soil management using lime was conducted based on the soil type and pH in acidic jhum uplands of Aotsakili village under Zunheboto district covering 2 hectares. It was observed that the pH was increased from 6.2 to 6.4 and the yield of maize (2300 kg/ha) over control (1600 kg/ha) with B:C ratio of 2.6. This technology was found to be beneficial to be practised for the farming community.

Key words: Acidic, Jhum, Lime, Maize

BORON CHEMISTRY IN ACID SOILS AND ITS MANAGEMENT

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Boron (B) is an essential micronutrient for plants, but the range between deficient and toxic B concentration is smaller than for any other nutrient element. Boron deficiency is in around 45% of the agricultural soils (Kumar *et al.*, 2016). Plants respond directly to the activity of B in soil solution and only indirectly to B adsorbed on soil constituents. The total B concentration in soils is in the range of 2-200 mg/kg dry weight, most of which is inaccessible to plants. Boron is present either as undissociated boric acid (pH 4-8) or as oxoanions, both very soluble under acid soil conditions. In acid soil, boron is present as Boric acid (H₃BO₃) which generally doesn't undergo any redox reactions, for which Boron chemistry in acidic soil is very simple but its availability is affected due

to various factors. A variety of soil properties have been identified as affecting the behavior of boron in acidic soils like soil pH (Hingston, 1964), soil texture, soil moisture, temperature, leaching, interaction with other nutrients (Hingston, 1964; Keren and Mezuman, 1981), clay content (Sims and Bingham, 1968), organic matter content (Berger, 1949; Gupta, 1968; Keren and Mezuman, 1981; Keren and Bingham, 1985). Balanced soil fertility generally results in improved boron uptake by plants. Some of the boron management strategies in acidic soils are tillage, liming, addition of organic manure, B-fertilizer (Gupta, 1979). Liming is found to greatly enhance B-availability in acid soil, however full dosage may not be given owing to B-fixation at higher pH (Sarkar *et al.*, 2015). Hence, boron chemistry is considered as unique as compared to other micronutrients owing mainly to pH and texture factors, also since amendments such as liming has a huge impact on its availability, thus its management should form an important part of fertilization schedule for the predominant crops and cropping systems.

Keywords: Boric, boron, deficiency, leaching, liming

GENETICALLY MODIFIED FOOD DETECTION: A MOLECULAR APPROACH

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Food produced from or using genetically modified organisms (GMOs) is referred to as GM food. With the change in the trends of human food habits, processed food poses a severe challenge to quality assurance. Food and feed in the Indian market require keen monitoring, it is essential to detect the adulteration (either intended and unintended) of non-certified GM food in non-GM food. Testing for GM food is essential for the legitimacy, biosafety and regulatory purposes. Labelling rules and trade requirements vary from country to country which necessitates for the development of reliable methods for the detection, identification and quantification of GM products. For the safety of humans, environment, animals and other related microflora, comprehensive molecular testing of newly developed GMO is essential before commercial release. GM foods can be identified by qualitative PCR techniques like a target-taxon specific method or using other screening methods based on target elements in the PCR and GM markers. However, there are other methods like chromatography and mass spectrometry, which have their importance in GMO testing. The combined use of more than one testing method would be beneficial for complete analysis, authenticity and biosafety assessment of GM samples. The detection and identification of GMOs are of great value in identifying the purity of food. Hence, some methods for precise testing are briefed in this study.

Key words: Genetic modification, food adulteration, bio-safety, PCR techniques, GMO detection, etc.

ROLE OF BIOCHAR TOWARDS SUSTAINABLE AGRICULTURE

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Biochar is a form of charcoal produced from slow pyrolysis of biomass. Found naturally in soils around the world as a result of vegetation inferno. Biochar has been created and used by the Amazonian inhabitants in traditional agricultural practices in the Amazon Basin of South America for more 2500 years ago. Terra preta (Dark charcoal rich soil or black soil) after mixing with the top soil are able to retain in vital minerals and nutrients which supports productive farms in areas that previously had poor and toxic soils. Biochar is a stable carbon (C) compound created when biomass (feedstock) is heated to temperatures between 300 and 1000°C, under low (preferably zero) oxygen concentrations. Biochar is stable and hence suitable for carbon sequestration, promotes plant growth in poor soils particularly when combined with nitrogen-fertilizers (Blackwell et al., 2009) and also reduces nutrient leaching (Major et al., 2010). The role of Biochar towards sustainable agriculture provides plethora of knowledge and so it's robust system in mitigating climate change which is of much more importance.

Keywords: Biochar, Sustainable, Agriculture, Pyrolysis, Amazon valley.

EFFECT OF PLANTING TIME AND HARVEST ON YIELD AND QUALITY OF GINGER (*Zingiber officinale* ROSC.) CV. NADIA

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In the present study, the effect of different planting time and harvest on yield and quality of ginger (*Zingiber officinale* Rosc.) cv. Nadia were evaluated. The experiment was laid out in Split Plot Design with dates of planting as main treatment (30th March, 30th April and 30th May) and five harvesting time as sub-treatments (6 MAP, 7 MAP, 8 MAP, 9 MAP and 10 MAP) with three replications. The study revealed that harvesting time effectively influenced on the quality of ginger. Planting time showed significant effect on almost all the characters except for fibre content. The quality of ginger rhizome such as oil content, dry recovery and oleoresin content had significant influence on both the planting time and the harvesting time. Planting of rhizomes on 30th April resulted better yield and yield attributing characters. Among different harvesting time, harvesting at 8 MAP recorded significantly higher fresh weight of ginger and quality characters. The treatment (M2H3) i.e. April planting time and harvesting at 8 MAP exhibited higher yield and yield attributing characters viz. length of finger (8.69 cm), girth of finger (8.09 cm), fresh weight of rhizome plant-1 (1310.03 g), yield plot-1 (11.98 kg), and yield ha-1 (31.53 t). Planting in the month of April and harvesting at 9 MAP (M2H4) recorded better quality rhizome with high oil (2.83%), oleoresin (15.74%) and dry recovery (23.83%) with less fibre content (4.9%) followed by planting in April and harvest at 8 MAP (M2H3). **Keywords:** Ginger, date of planting, date of harvest, yield and quality, Nadia.

DEVELOPMENT AND NUTRITIONAL EVALUATION OF BAEI POWDER USING DIFFERENT DRYING METHODS

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The study were carried out to evaluate the effect of different varieties of bael (Pant Aparna, Pant Shivani and Pant Urvashi) drying by different method such as open sun drying, tray drying (60°C and 70°C) and hot air oven drying (60°C and 70°C). The Nutritional properties of bael powder such as moisture content, ash contents, protein content, rehydration ratio, pH, fiber content, ascorbic acid powder were decreased with increase in drying temperature. The result showed that bael powder of Variety Pant Aparna at 60°C cabinet tray drying and Variety Pant Aparna by open sun drying had highest nutritional properties as compared to others treated bael powder. Bael powder has good powde which enhance the nutritional quality of the value added products.

Introduction Bael (*Aegle marmelos L.*) belongs to Rutaceae family and it is an indigenous fruit of India. Its common names in India are Bengal quince Bilva, Indian quince, Bel, Belwa, Sripthal, Stone apple, Golden apple, Holy fruit and Maredo. Bael is a sacred tree in Hindu religion and it is offered to Lord Shiva and Parvati in prayers. Arid conditions are tolerable by this plant as well as high rainfall. Explorations are taken to witness to indicate the wide range of variability in thorniness on stem, fruit shape, scull thickness and pulp characteristics in eastern Uttar Pradesh and adjoining area of Bihar. High yield and quality fruits were identified as promising prospects. The production of bael in India is 85.83 000 tonnes in 2015-16. Drying is the process of removal of most of the moisture present in the food. It is the oldest preservation method applied since ancient times. The removal of moisture from the food materials prevents the growth and reproduction of spoilage microorganisms, slows down the action of enzymes and minimizes many of the physical and chemical reactions. Bael drying can be done in many ways. The most common technologies for drying are convection, cabinet tray, hot air oven and open sun drying that form a “free-flowing” powder. The raw material was washed thoroughly in running water to remove the adhering soil and extraneous matter. The undesirable portions were removed manually. They were again washed and cleaned properly soil dirt and other foreign matters were removed. The following Bael varieties weretaken for conducting the experiment V₁ (Variety Pant Aparna), V₂ (Variety Pant Shivani) and V₃ (Variety Pant Urvashi). The selected variety of bael was procured from university and stainless steel knife were used in Peeling/Remove the hard shell. The Scooping of Pulp with seed and fibers. The cleaned product was weighed 500 g. The bael samples were dried using three methods viz.; open sun drying, cabinet tray drying (60°C and 70°C) and hot air oven drying (60°C and 70°C). The Bael powder was prepared by the process washing, pulping, drying, grinding and sieving.

Conclusion

The Nutritional properties of bael powder such as moisture content, ash contents, protein content, rehydration ratio, pH, fiber content, ascorbic acid powder were decreased with increase in drying temperature. The result showed that bael powder of Variety Pant Aparna at 60°C cabinet tray drying and Variety Pant Aparna by open sun drying had highest nutritional properties as compared to others treated bael powder. The results concluded that drying temperature and bael varieties has significant effects on the Nutritional Properties of bael powder. From the results of the research carried out, it can be concluded that Variety pant aparna bael powder in cabinet tray dried at (60°C) exhibited best results over the drying methods are most suitable for drying bael.

VARIETAL SCREENING OF CHILLI (*Capsicum annum* L.) AGAINST MAJOR SUCKING PESTS

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Investigations on “Varietal screening of chilli (*Capsicum annum* L.) against major sucking pests” were carried out at Samajik Vigyan Kendra, Dr. B. R. Ambedkar University Rehti, (Village Bordi) Tehsil- Nasrullaganj, Distt- Sehore (M.P.) during Rabi, 2018-19 and 2019-20. Out of ten varieties of chilli screened against major sucking pests (mites and whitefly). none of the variety was found completely free from the attack of pests. The varieties, VNR-577, VNR-109, VNR-277, VNR-1921, US-1003, US-9009, US-7030, MHCP-310, MHCP-317, and PusaJawala host plant resistance is an ideal component of IPM at no additional cost as preventive measures, however they were continuously replaced by new high yielding varieties, hence in the present study eight new varieties were included to screen for their susceptibility against major sucking pests (mites and whitefly). The results revealed that none of the varieties screened against major sucking pests of chilli for their susceptibility was found completely free from the infestation of pests.

Keywords:Chilli, mites, white fly, varietal screening.

The mean population (Pooled) of mites and whitefly ranged from (7.18 to 11.71 and 6.74 to 12.89 per three leaves). The minimum mites and whitefly population was observed on VNR-277 (7.18 and 6.74, /three leaves), and VNR-577 (7.34 and 6.85/three leaves). The non significant difference existed among these varieties. whereas, maximum was on PusaJawala (11.71 and 12.89/three leaves) and US-1003 (10.56 and 12.34/three leaves). The rest of the varieties, viz. US-9009, MHCP-310, MHCP-317, US-7030, VNR-1921 and VNR-109 harboured mites and whitefly population ranged from 8.04 to 10.11 and 8.16 to 11.43 per three leaves and ranked in the middle order of infestation.

Based on statistical categorization on the basis of peak population of mites and whitefly the varieties, VNR-277, & VNR-577 were found to be least susceptible, US-9009, MHCP-310, MHCP-317, US-7030, VNR-1921 and VNR-109 were categorized as moderately susceptible and variety PusaJawala and US-1003 as highly susceptible.

Leaf curling percent in chilli

The minimum leaf curling of 30.45 percent was also recorded in the least susceptible varieties, VNR-277, followed by VNR-577 (32.03%) and maximum was in highly susceptible varieties, PusaJawala (53.59%) and US-1003 (51.17%). The rest of the varieties viz., US-9009, MHCP-310, MHCP-317, US-7030, VNR-1921 and VNR-109 were moderately susceptible which exhibited leaf curling of 35.91, 36.61, 37.74, 45.03 and 45.19 percent, respectively.

Yield performance of different chilli varieties

The maximum fruit yield of 77.61 q ha⁻¹ was recorded in variety VNR-277, followed by VNR-577 (74.85 q ha⁻¹) and US-9009 (73.88 q ha⁻¹). And Minimum fruit yield was recorded in the variety PusaJawala (50.08 q ha⁻¹) and US-1003 (52.17 q ha⁻¹). The other varieties viz., MHCP-310, MHCP-317, US-7030, VNR-1921 and VNR-109 gave fruit yield of 68.00, 68.44, 64.39, 64.05 and 61.81 q ha⁻¹, respectively.

BAMBOO BASED AGROFORESTRY MODEL FOR FAREMERS LIVELIHOOD SECURITY

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Bamboo a woody grass is not only an ideal economic investment that can be utilized in many different manners but also has enormous potential for elevating many problems. The increasing rate of deforestation makes the search for alternative natural resource important. The characteristics of bamboo are a perfect option for reforestation. Its biological characteristics make it a perfect tool for solving many environmental problems such as soil erosion water runoff and CO₂ sequestration. On account of extensive rhizome root system and accumulation of leaf mulch bamboo serves as an efficient agent in preventing soil erosion conserving moisture reinforcement of embankments and drainage channels etc. Agro forestry refers to land use systems in which trees are grown in association with agriculture crops, pastures or livestock. The association maybe in time such a rotation between trees and other components or in space with the components grown together on the same land. Agro forestry has both productive and service functions the distinctive contribution to production is to obtain tree products from the farm; these include the fuel wood, water and fruit , fiber including other items such as gums, resins thatching and medicinal products. This range of productive serves to diversify the output from farms giving a broader economic base and greater food security. Agro forestry can contribute to all these aspects and it has a major role to play in some of these. Agro forestry is suited to soils of low fertility and to degraded lands owing to the potential of many trees to grow on poor soils and their soil regenerative capacity. In view the capacity of trees under difficult climatic and soil conditions coupled with their potential for soil conservation Agro forestry is particularly well-suited to adverse environment and main types of marginal lands but has a potential also on more fertile soils. Bamboo can be grown under all Agro forestry land systems but in Assam Asian countries it has been generally grown in home gardens. Bamboo is used for variety of purposes like food, fodder, fuel, fencing pulp and paper house construction cottage industries etc these multiple users meet the basic needs of the villages farmers rural poor bamboos enrich the soil through leaf litter the composition and band the earth against ranging floods. Bamboo has good capacity power and the green off cal main product produce suits after cutting.

Keywords: Bamboo, Agro forestry, Livelihood security.

PREBIOTIC TO IMPROVE GUT MICROBIOTA AND BOOSTER OF IMMUNITY

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Today we are all aware of how important it is to fight against the pathogens and to protect you from the infections, this is our immunity which protects us from all kinds of bacteria and virus and keep safe from the infection. For healthy well being it necessary to have a healthy gut which depends on the healthy gut micriobiota such as depression and lung disease. The immune system is the main link between gut bacteria and their influences. Throughout life we are constantly exposed to new things in our gut, via food and environment such as food additives, pollution in the air or non- pathogenic

microorganisms in dust or dirt. Only healthy immune system handles all of these invading objects with ease. The essential task of the immune system is to maintain a balance between tolerance and reaction which takes place inside the gut, and a diverse gut flora established in early life with many types of bacteria, fungi and other microorganisms. Prebiotic have beneficial effects of stimulation of immune system, which can directly increase population of beneficial microbes of Prebiotic, especially lactic acid bacteria and bifidibacteria in the gut. An important mechanism of action of Prebiotic, by which they can affect the immune system, is changing the expression of cytokines. Prebiotic are short chain carbohydrate that after the composition, or metabolism of the gut microbiota in a beneficial manner. A large of investigations and intervention program have been perform and that have demonstrated that consumption of dietary Prebiotic food product can statistically significant changes in gut microbiota which are helpful in boosting immune system. Objective of this study is to find out the role of Prebiotic in immunity booting. And hypothesis formed that prebiotic food are helpful in improving immunity. Result of this study shows that those respondents taking Prebiotic in their diet their immune response is better that those who are aware of this.

Key words: Gut health, Immunity, Prebiotic. Microbiota.

CORONOMIC: THE DISASTROUS IMPACT OF COVID-19 ON AN INDIAN ECONOMY

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Since the Covid-19 outbreak was first diagnosed and reported in Wuhan City of China, it has spread to over 200 countries. COVID-19 is the greatest global humanitarian challenge to world after the World War II. The virus has spread widely, and the number of cases is rising daily instead of enormous efforts of governments and non-government organizations to contain the spread of COVID-19. India too has experienced a significant increase in the number of cases since the beginning of first report of COVID-19 on 30th Jan, 2020 at Kerala. The government has taken necessary action to flatten curve by imposing national lockdown and complete ban on travel. The outbreak and lockdown is disturbing social activities and inhibiting the growth of entire economy activities. The government has taken necessary and stringent action to flatten curve by imposing National complete lockdown for 68 days and complete ban on travel. But still the cases are rising continuously with low mortality rate. After unlock 1.0, 2.0 and 3.0 the cases are increasing alarmingly with resumption of the economic activities at many front. In this article we are trying to focus on impact of Covid-19 on different sectors of Indian economy.

Key words: COVID-19, outbreak, Indian economy, lockdown, economic cost

A1/ A2 MILK CONTROVERSY: MYTH OR REALITY

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Casein proteins, which form about 80% of the bovine milk proteins, form large colloidal particles with calcium phosphate to form casein micelles. Casein micelles are composed of four main types of proteins: α S1-casein, α S2-casein, β -casein, and κ -casein. Many reports show casein derived bioactive peptides with antioxidant, antimicrobial, immunomodulatory, mineral binding, antithrombotic and antihypertensive properties. However in 2007, a book entitled, "Devil in the Milk" authored by Keith Woodford's in 2007 created a breakthrough that consumption of A1 type of milk lead to many serious illnesses like heart disease, Type 1 diabetes, autism and schizophrenia. On the basis of a seven amino acid long peptide beta casomorphin-7 (BCM-7) production; milk is divided into A1 and type A2. Type A1 milk on enzymatic digestion by pepsin, leucine aminopeptidase, elastase, trypsin and pancreatin produces BCM-7 but A2 does not produce. This is because of mutation that changed proline to histidine at position number 67 in β -casein of type A1 milk. The status of A1 or A2 beta casein variants from different countries have shown that the presence of A1 variant in European cattle has been linked to a range of illnesses. On the other hand, controversial reports are available that link consumption of BCM-7 with physiological aspects that are beneficial to animals such as protective effects against diabetes and oxidative stress and modulation of intestinal mucus discharge and defence against noxious agents. With the establishment of A2 Corporation Ltd in New Zealand, it emphasized to market A2 milk as a premium brand in New Zealand, Australia, Asia and the USA. However, there is considerable uncertainty due to lack of an authentic validation and appropriate mechanism. Moreover, it is very important to note that India possesses mostly A2 rich dairy animals and our buffaloes are 100% A2 type. Therefore, we Indians should not be panic on the A1/A2 controversy and consume the milk and milk products. We can also exploit this opportunity to get the maximum return by exporting the A2 milk to the demand driven countries.

Key word: Casein, BCM-7, A1/ A2 Milk, Mutation, Controversy

EFFECT OF INCORPORATION RATIO OF POTATO FLOUR ON PHYSICAL PARAMETERS OF COOKIES

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Potato is a versatile, carbohydrate-rich food. When freshly harvested, it contains about 80 percent water and 20 percent dry matter content. About 60 to 80 percent of the dry matter is starch. On a dry weight basis, potato protein content is similar to cereals but very high when compared with other root and tuber crops. Potato plays an important role in world food security. It is a versatile and carbohydrate rich food which contains about 80% water and 20% dry matter content. The knowledge of important physical properties such as shape, size, volume, density, thickness and spread ratio are necessary for designing of baking equipment, packaging materials, handling and storage system. The cookies were prepared from the flour having various incorporation ratios of potato flour and wheat flour. The physical properties (diameter, thickness, volume and spread ratio) of potato cookies were determined for freshly prepared samples. The study concluded that physical properties were greatly affected by the incorporation of potato flour.

Key words: Cookies, Potato flour, Wheat flour, Spread ratio and Volume

INFLUENCE OF PRE-TREATMENT ON PHYSICO-CHEMICAL PROPERTIES OF POTATO FLOUR

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Potato belongs to family *solanaceae* and plays an important role in world food security as it is a cheaper and plentiful crop. It is a versatile, carbohydrate-rich food. It is the most important tuber crop in the world. The pre-treatments on fruit and vegetables before drying in one form or other viz., washing in water, blanching, KMS, sugar, salt either alone or in combination inhibit enzymatic browning, enhancing color, flavour and texture retention. The investigation was done to study the effect of pre-treatments viz., blanching, brine solution, KMS plus blanching and KMS solution on physico-chemical properties of potato flour (KufriChipsona -1, Kufri Jyoti and KufriBahar). The physico-chemical properties such as moisture content, fat, fibre, pH, ash and protein content were determined during storage of 120 days.

It was observed that pretreatments have significant effect on physico-chemical properties of potato flour.

Key words: Potato flour, Pre-treatment, Fat, Protein.

PROTECTED VEGETABLE PLANT PRODUCTION: AN BUSINESS

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It is very essential for high quality vegetable production or vegetable seed production so that the plant is healthy and disease free. Vegetable plants are sensitive to many diseases, mainly due to virus-caused diseases, because these plants are delicate, hairy and very soft. other side Seeds of high quality vegetable hybrid varieties are expensive. Because these seeds are found in 25-50 times more mating than free pollinated species. Therefore it is necessary that vegetable plant production should be done in proper conditions. That is why it is necessary that vegetable plant production should be done in proper direction. Nowadays, due to technological progress and low quality planting material with high quality, plant production has taken the form of a business. Plastic multicellular trays can be used to make the shape of each plant, and artificial the soilless has made it possible to control the banality rate of every plant. The size of the cell in the tray is suitable for growing the plant without soil, for growing the root and controlled essential water, also for providing nutrients. Vegetable plants have many advantages to grow in a state-of-the-art nursery like: 1- possibility to grow virus free plants. 2-No problems of soil borne diseases and nematodes. 3-Chances of seasonal plant emergence. 4-Low seed strength. 5-Good root bud in the plant. 6- No death rate 7-The ration can be taken as a small business, easy to take care of and to remote places. Cultural and morphological variations among the isolates of *Sclerotinia sclerotiorum*(Lib.) de Bary causing stem rot of mustard in India

Keywords: Protected vegetables, Business, diseases

CULTURAL AND MORPHOLOGICAL VARIATIONS AMONG THE ISOLATES OF *Sclerotinia sclerotiorum* (LIB.) DE BARY CAUSING STEM ROT OF MUSTARD IN INDIA

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The present investigation was carried out to the variations in the isolates of *S. Sclerotiorum* collected from mustard fields in different districts of Uttar Pradesh and Rajasthan (India). The observations showed variations in cultural and morphological characteristics i.e., colony colour and texture, and apparent variation in sclerotial formation, number, size, pattern and weight when grown on PDA. Among all isolates SsM and SsH were found significantly fast growing followed by SsB, SsAL and SsA. All isolates produced sclerotia in 5-8 days. Maximum number of sclerotia (49) was formed in isolate SsM, while as minimum (21) in SsA. Larger size of sclerotia (6.9×3.2 mm) was found in SsH, while smallest (3.6×3.1 mm) in SsA. Maximum weight of sclerotia was recorded in isolate SsB (1.2 mg) however other isolates varied in their ranging (0.2-0.9 mg). Therefore, the present observations are evidence with the existence of variability among the different geographical isolates.

AGRITECTURE – AN INNOVATIVE APPROACH TO THE MODERN AND SUSTAINABLE AGRICULTURE

**Sustainable Agriculture ABHINAV MIGLANI¹, SUDAKSHINA MISHRA²
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Agritecture is the art, science and practice of incorporating agriculture into the built environment. It is the fusion of agriculture and architecture. Agritecture consists of buildings that grow food. This integration process is emphasized to get maximum plant growth using the benefits of density indoors and microclimates outdoors. Agritecture is the unification of productivity and creativity in a very smart and scientific manner. This technique is mainly used in crops like (lettuce, broccoli, Tomato, Brinjal, Maize, Sorghum etc). The ultimate aim of agritecture is to improve the quality of agricultural products and persons who lives in the agricultural community. Agritecture is a smart agriculture technique in which more production with high quality products are obtained from a very small area. Agritecture includes vertical farming, rooftop farming, living walls and hydroponics. It reduces the water wastage, reduces the overuse of fertilizers, minimize the environmental pollution and produce pest free healthy products. Through the use of agritecture, people can now cultivate crops and grow food in urban areas. With this techniques people can grow off season crops by adjusting the micro-climate in the buildings and hatch extra income from this. Agritecture is an emerging technique in agriculture. Different remote sensing techniques that are used in the agritecture reduce the manual work load produces the quality products at proper time. This technique leads to the production of organic products as less chemicals and intensive monitoring is done. Agritecture complete the needs of increasing population in a very smart way. So, it also plays an important role in sustainable agriculture and modern farming.

Keywords: Agritecture, Vertical farming, Hydroponics, Microclimate, Remote Sensor

MOLECULAR CHARACTERIZATION OF GENETIC DIVERSITY BETWEEN WILD POMEGRANATE ACCESSIONS

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Wild pomegranate (*Punica granatum* L.), belonging to family Punicaceae is one of the oldest fruits growing in foothills of Himalayas including Jammu and Kashmir. Assessment of genetic diversity present in this plant will be useful for identification of new germplasm sources. DNA was isolated from young leaves of fifty trees of wild pomegranate accessions collected from five different altitudes. Fifty RAPD primers were used for detecting polymorphism. A total of 160 bands were observed in the size ranging from 250 to 2500bp. Out of 160 bands, 116 were polymorphic with 71.3% polymorphism and a mean of 3.31. Genetic dissimilarity was calculated between the accessions using DARwin 5.0 and it ranged from 0.093 to 0.429. The lowest value 0.093 was obtained between accessions collected from Udhampur, while the genetic dissimilarity between accessions collected from Udhampur and DherakiGali was maximum. A dendrogram was generated based on the dissimilarity using Neighbour joining approach, showing presence of three main clusters with sub clusters. The clear separation in the UPGMA tree reflects as strong relationship of genetic differentiation among the wild accessions of pomegranate collected from different locations. Accessions present in same cluster indicate that they may have same genetic make-up with no genetic difference. The results are informative to unravel the genetic variations present in wild pomegranates.

ORGANIC FARMING IN PRESENT AGRICULTURE SCENARIO MIKHIL MILTON¹, VINAI KUMAR² AND DIPTI BISARYA^{3*}

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Green revolution being played a remarkable role in alleviating hunger and ensuring food safety has also created many ill effects on the environment and human health. Organic farming is the best in hand solution for countering ill-effects of present agriculture system. As organic farming is a sustainable approach without harming the environment and human health whereas improves the soil quality, microbial population and also produces organic and healthy food. No doubt, the advantages of organic farming will outshine its disadvantages but on the practical side, it has got several constraints as it is unable to satisfy the increasing food demand and thus a challenge to the national food security, lack of knowledge, limited availability of organic fertilizers and manures, profitability to the farmers and affordability of organic produce by the consumers are some of the problems of organic farming in hand. Considering the rising demand for organic products both nationally and internationally, with proper implementation of policies encouraging organic farming their implementation and marketing there is great scope for the organic food industry to create a huge positive impact on the Indian economy.

Keywords: Organic farming, Green revolution, human health, environment, Indian economy

ACOUSTIC FREQUENCY RESPONSES IN PLANTS

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Sound is an acoustic energy in the form of a mechanical wave which transmits through gases, liquids and solids. Acoustic spectrum consists of three regions, infrasound (less than 20 Hz), audible region (20-20,000 Hz) and ultrasound (greater than 20,000 Hz). Infrasound and ultrasound are used in clinical diagnosis and therapeutics. Studies have revealed that audible sound stimulation has a great potential to improve plant growth and the quality of plant produce. Plant Acoustic Frequency Control Technology (PAFCT) is a new technique which uses acoustic frequency generator to produce appropriate acoustic waves that matches the frequency of the specific sound of plants. The effect of sound wave depends greatly on the intensity, frequency, exposure time and period of application. It can either enhance or restrict the growth of plants. The perception of audible sound by plants and their responses are not completely understood. The possible mechanisms proposed by scientists are enhancement of protoplasmic streaming, regulation of plasma-membrane H^+ ATPase activity and increased rate of transpiration caused by leaf canopy surface vibration. The mechanism of how acoustic frequency affects the cell cycle and growth of plants needs further research. Field experiments are needed to promote this technology for enhancing productivity of different crops.

Keywords: Acoustic Frequency, Sounds, Perception.

EFFECT OF POTASSIUM SILICATE AND SALICYLIC ACID ON PHYSIO-BIOCHEMICAL CHARACTERISTICS OF MANGO MALFORMATION

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Mango (*Mangifera indica* L.) is commercially the most important fruit crop of India, accounting for more than 54% of the total mango produced worldwide. Malformation causes gross distortions of vegetative and floral tissues in mango. Floral malformation is a serious disease threatening production of mango in the world, since the effected panicles do not set any fruits. Depending on the cultivar and severity of symptoms, yield losses from 60% to 100% are reported. Several physiological, biochemical and biological factors have been reported to cause malformation in mango. Convincing evidence that a fungus causes malformation has been in the literature for decades. The most effective management of disease includes the avoidance of inoculums, selection of resistant varieties and the potential control of disease are targeted to eradicate the causative agent. Physical alteration followed by chemical treatment like Prochloraz and benomyl spray results in the reduction of disease incidence and increment of yield. In the present investigation Potassium Silicate and salicylic acid was sprayed thrice in a week at flowering stage and a field experiment with two mango cultivars (Amrapali and Desheri) was performed using factorial randomized block design in the three replications. The impact of potassium silicate (0.25, 0.50, 0.75%, 1, 2 and 5%) and salicylic acid (.25 ppm, .50ppm, .75ppm, 1ppm) on photosynthetic pigment content, % flowering, % malformation and antioxidant enzyme activity was evaluated. The result revealed that the total chlorophyll content and total carotenoids were increased with increasing potassium silicate concentration as compare to control. It was found that Chlorophyll content was more in Amrapali as compare to Desheri. The activity of catalase was also enhanced with increasing Potassium Silicate and salicylic acid concentration while maximum catalase activity was observed in Desheri as

compared to Amrapali. It was concluded that catalase is the most effective intracellular enzymatic antioxidant which is ubiquitous in all aerobic organism and in all subcellular compartments prone to ROS mediate oxidativestress. The % malformation decreases with increase potassium silicate concentration and found maximum in Amrapali as compared to Desheri.

MICRO-CLIMATIC CHANGES AND CROP PERFORMANCE UNDER PHENOLOGICALLY DIFFERENT TREE SPECIES

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Field investigation entitled ‘Micro-climatic changes and crop performance under phenologically different tree species’ was carried out during Feb 2014 to Jan 2015 at the experimental area of the Department of Forestry & Natural Resources at University Seed Farm, Ladhawal, Ludhiana. The experiment was conducted during February 2014 to January 2015 in the three phenologically different tree species [*Ailanthus excelsa*(summer deciduous), *Gmelina arborea*(winter deciduous) and *Eucalyptus tereticornis*(evergreen)] raised in August 2005 (6m×6m spacing). Turmeric crop (Punjab haldi 1) was sown under plantations of three trees species and in control in the month of May 2014 and harvested in February 2015. The experiment was laid out in Completely Randomized Design and data were recorded in three replications for each treatment including tree-less plot. Results of present study clearly indicated micro-climatic modifications under tree canopy as compared to open condition, thus influencing the under-storey crop growth and yield. Air temperature, soil temperature and light intensity under tree canopy was 5.6%, 11.3%, 53.8%, respectively, less as compare to open however relative humidity was 2.9% more. Soil physico-chemical properties improved under plantation than open conditions with improved OC in the top layer (0-30cm) and decrease thereafter. The maximum crop yield was recorded in control but good harvest was recorded under tree canopy as well with least influence of phenological behaviour of tree species. These results indicate that turmeric is suitable for cultivation under diverse species. Since turmeric is in much demand, therefore its cultivation can improve the socio-economic status of the cultivators.

Keywords: Micro-climate, Turmeric, Tree Phenology, Tree biomass, Crop yield

PRECISION FARMING: A WAY TO SUSTAINABLE AGRICULTURE

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Global population is expected to go 9.7 billion to nearby 2050 and food production must be double of the current levels to feed every person. With relevance of over 60 percent of world population on agriculture for food, the pressure to increase the produce to meet demands does not seem to ease. beside with global climate change, which is leading to be increase in in global temperatures, levels of CO₂ and incidence of droughts and floods, along with increasing labor costs, high production cost, and unpredictability of production of a major challenge to the future of agriculture. Hence, the goal is to enhance crop productivity in a sustainable way. Advanced analytical technology and

constantly improving Precision Farming will be key elements in third revolution, it making each farmer capable of feeding 256 people. Precision Farming or Precision Agriculture is a technological revolution in agriculture production generally is defined as information and technology based farm management system to identify, analyses and manage spatial and temporal variability within fields for to increase agriculture productivity, Prevents soil degradation, Reduction of chemical application in crop production, Efficient use of water resources, Dissemination of modern farm practices to improve quality, quantity and reduced cost of production, Developing favorable attitudes and also changing the socio-economic status of farmers. The use of inputs in precision farming (i.e. Synthetic chemical fertilizers and pesticides) based on the definite quantity, at the definite time, and in the definite place. This type of management is generally known as “Site-Specific Management (SSM)”. The crop productivity occur in global food supply have increasingly relied on expansion of irrigation technologies over recent decades, with more than a third of the world's food production is depend on irrigation for production. Conventional farming practices are area-centric. There is a general set of cropping pattern throughout an area all the farmers in that area follow the same trends such as sowing, nourishing, irrigation and harvesting period etc. What these practices result in is: unpredictability, overuse of resources and uncontrolled waste production. The major technologies use in precision farming are Global Positioning System (GPS) receivers, Differential Global Positioning System (DGPS), Geographic information systems (GIS), Remote sensing, Variable Rate Applicator, Combine harvesters with yield monitors. Some Drawbacks of precision farming is also observed like High cost, Lack of technical, expertise knowledge and technology, not applicable or difficult/costly for small land holdings, Heterogeneity of cropping systems and market imperfections. So it conclude that use of site specific management of agriculture crop production it best way to modernizations in agriculture, cost effective and also increasing the farmers income.

Keywords: Precision forming, GIS, GPS, Cropping pattern, Remote sensing.

NATURAL RESOURCE MANAGEMENT AND ITS IMPORTANCE TO INDIAN AGRICULTURE.

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Degradation of natural resources has a direct negative bearing on livelihoods of poor people. Natural resource management is an interdisciplinary field of study that deals with the physical, biological, economic and social aspects of handling natural resources such as air, water, animals and land. The basic objective of NRM to develop technologies for conservation, management and sustainable utilization of the natural resources ensuring food, nutritional and environmental security in the country through various research programmes. The NRM research programmes have been prioritized within the perspective of different themes, viz., soil inventory and characterization, integrated soil-water-nutrient management, watershed management, resource conservation technologies, crop diversification, integrated weed management, integrated farming system including agroforestry, dryland farming, arid, coastal and hill agriculture, abiotic stress management, climate resilient agriculture, conservation agriculture, waste water utilization, solid waste management and applications of nanotechnology to enhance nutrient and water use efficiency.

Keywords: Natural resource management, soil, air and water etc.

INDIRECT ROLE OF COVID 19 VIRUSES OVER FOOD NUTRITION AND LIVELIHOOD OF FARMERS

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The COVID-19 pandemic is also a world health crisis that's already having shocking impacts on the world economy – both straight and through required measures to contain the spread of the disease. These impacts are being felt by the food and agriculture sector. While the supply of food has belated well to this point, in many countries, the measures put in place to contain the spread of the virus are becoming right down to disrupt the availability of agro-food products to markets and consumers, both within and across borders. The world is moreover experiencing a substantial shift within the composition and for some commodities the quantity of demand. How damaging these impacts influence be for food security, nutrition and also the livelihoods of farmers, fishers and other working along the food supply chain will depend in large part on strategy responses over the short, medium and future. Within the short term, governments must manage multiple demands responding to the health crisis, managing the implications of the shock to the economy, and ensuring the elegant functioning of the food system. While the deadly disease poses some stern challenges for the rations synchronization within the short term, it is also a chance to speed up transformation within the food and agriculture sector to make its flexibility within the face of a spread of challenges, together with action.

Key words: Food, disease, agro market, demand etc.

INCIDENCE OF WHITE ROT OF ONION CAUSED BY *SCLEROTIUM ROLFSSII* IN MANIPUR

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White rot of onion caused by *Sclerotium rolfsii* found in an alarming condition at various commercial onion growing locations in the valley districts of Manipur. The disease incidence ranged between 38.00% and 67.42%. The maximum disease incidence was observed during the month of April in Imphal West (65.58%), followed successively by Bishnupur (64.09%), Thoubal (61.45%) and Imphal East (59.24%). The highest disease incidence was recorded in Imphal West district during the crop season. The disease intensity was highest in Malom viz., 46.40, 55.34 and 67.42% during February, March and April respectively. The lowest disease incidence was observed in Imphal East district with minimum disease intensity being recorded from Pukhao viz., 38.38, 48.12 and 56.40% during February, March and April respectively. The symptoms of white rot were not obvious during the first three months after planting. It became prominent in the month of February with yellowing of leaves followed by wilting as the disease progresses and most prominent at April when the base of onion stem starts rotting and eventually become covered with white fluffy mycelial growth of the fungus in the presence of sclerotia. When such plants are uprooted, the roots, base plate, bulb scales and sometimes, the entire bulbs are decayed and watery. The disease incidence was less in February and March in all the locations. However, the disease was more severe starting from April after the commencement of rain, probably due to the impact of rainfall resulting in inoculum spread, high relative humidity and low soil temperature (17-20°C).

EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON THE LEAF NUTRIENT CONTENT OF AFRICAN MARIGOLD (*Tagetes erecta*L.)

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Marigold has become one of the most important crops in the country to be cultivated commercially for its loose flowers utilized in various occasions. An experiment was laid out with marigold variety, Summer Sugat at Andro Research Farm of Central Agricultural University, Imphal, during 2016-17. The experiment was laid out in Randomized Block Design with 11 treatments and each treatments replicated thrice. The treatments consisted of 100 per cent RDN (Control) (T₁), 100 per cent N from FYM (T₂), 100 per cent N from vermicompost (T₃), 75 per cent N (Urea) + 25 per cent N (FYM) (T₄), 50 per cent N (Urea) + 50 per cent N (FYM) (T₅), 50 per cent N (Urea) + 50 per cent N (FYM) + *Azospirillum* (T₆), 75 per cent N (Urea) + 25 per cent N (Vermicompost) (T₇), 50 per cent N (Urea) + 50 per cent N (Vermicompost) (T₈), 50 per cent N (Urea) + 50 per cent N (Vermicompost) + *Azospirillum* (T₉), 25 per cent N (Urea) + 75 per cent N (FYM) (T₁₀) and 25 per cent N (Urea) + 75 per cent N (Vermicompost) (T₁₁). The results generated from the experiment showed that among the different treatments, treatment with 50 per cent N (Urea) + 50 per cent N (Vermicompost) + *Azospirillum*(T₉) recorded the maximum leaf N content (1.51 %), leaf P content (0.44 %) and leaf K content (1.33 %) and this was followed by the treatment of 50 per cent N (Urea) + 50 per cent N (FYM) + *Azospirillum* in the leaves of the marigold variety. The minimum nutrient content in the leaves was observed in the treatment of 100 per cent N from FYM (T₂) where leaf nitrogen, phosphorus and potassium content was recorded as 1.41, 0.19 and 1.08 % respectively.

Keywords: African marigold, *Azospirillum*, vermicompost, FYM

DEPTH-WISE DISTRIBUTION OF MICRONUTRIENT CATION IN SOILS UNDER *JHUM* CULTIVATION IN CHANDEL DISTRICT, MANIPUR

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Jhum is one of the main forms of agriculture in North Eastern Region (NER) of India. Shifting cultivation or *jhum* often involves clearing of a piece of land followed by wood harvesting or farming. Soil plays a major role in determining the sustainable productivity of an agro-system. The sustainable productivity of a soil mainly depends upon its ability to supply essential nutrients to the growing plants. Micronutrients are essential nutrients that are required in small quantities for the normal growth and development of plants. They have the same importance as macronutrients to complete the life cycle of plants. There is wide variation in the micronutrient content of the soils. This study was to determine the distribution of DTPA-extractable micronutrient cations (Fe, Cu, Mn and Zn) in soil profiles and their relationship with soil physico-chemical properties. Soil samples

were collected from twenty different *jhum* sites of Chandel district of Manipur. DTPA- extractable micronutrient (Fe, Cu, Mn and Zn) content showed decreasing tendency with depth except for few samples. Surface layers accumulate higher content of the micronutrients than the lower layers of the soil profiles. DTPA- extractable Fe, Cu, Mn and Zn ranged from 10.27 to 159.00 mg kg⁻¹ soil, 0.04 to 3.21 mg kg⁻¹, 0.44 to 38.67 mg kg⁻¹ and 0.10 to 1.67 mg kg⁻¹, respectively. The contents of DTPA- extractable Fe and Mn were sufficient in all the profiles while Cu was adequate in majority of the soil samples with the exception of a few samples. However, 51.25 per cent soils were deficient in DTPA-Zn content.

Keywords: DTPA-Micronutrient cations, *jhum*, soil profile.

EFFECT OF INTEGRATED WEED MANAGEMENT ON INDIAN MUSTARD (*Brassica juncea*)

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Oilseeds are backbone of agricultural economy of India since long and considered as the second largest agricultural commodity in India after cereals. Edible oils are the concentrated source of energy, essential fatty acids (linoleic and linolenic) and carriers of fat soluble vitamins (A, D, E and K). These crops have an important role in agriculture and industrial economy of India. Mustard is one of the major Rabi oilseed crops of India. It is also known as Rai or Laha. Among numerous components of production technology, weed control in Indian mustard needs due attention as this crop is grown in poor soils with poor management practices, weed infestation is one of the major causes of low productivity. The experiment was conducted in Randomized block design (RBD) with 7 treatments. The predominant weeds present under experimental conditions were *Chenopodium album*, *Fumaria parviflora*, *Cynodon dactylon* and *Cyperus rotundus*. All the weed control treatments significantly reduced the weed population, dry matter of weeds. It also recorded highest weed control efficiency and minimum weed index over weedy check. Among the herbicidal treatments, Pendimethalin 30EC @0.750 kg+ 1HW was superior in recording highest yield attributes viz., plant height, plant population, dry matter, Seed/ siliqua, siliqua/ plant, length of siliqua and 1000 seed weight than the rest of the treatments. Yield (Seed, stover and biological yield) were recorded highest under the sequential application of Pendimethalin 30EC @0.750 kg+ 1HW and harvest index was recorded highest with the application of Pendimethalin 30EC @0.750 kg which was at par with application of Clodinafop 15WP @0.060 kg. Nitrogen and sulphur uptake from seed as well as stover was significantly highest with application of Pendimethalin 30EC @0.750 kg+ 1HW among the herbicidal treatments. Also the oil content and yield was recorded maximum with application of Pendimethalin 30EC @0.750 kg+ 1HW which was at par with application of Pendimethalin 30EC @0.750 kg alone. Even the cost of cultivation, gross return, net return was highest incurred with the application of Pendimethalin 30EC @0.750 kg+ 1HW whereas B: C was incurred maximum with application of Pendimethalin 30EC @0.750 kg alone. Overall among the herbicidal treatments the application of Pendimethalin 30EC @0.750 kg+ 1HW proved to be significantly superior to the other treatments.

Keywords: Mustard, Weed, Plant, Herbicidal treatments

IMPACT OF DIFFERENT LEVELS OF PYRAZOSULFURON-ETHYL ON THE WEED ECOLOGY OF LOWLAND RICE (*Oryza sativa* L.)

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Cereals are considered as the most important food crops throughout the world and play major role in our household and nutritional value. Among cereals, rice has been the staple food where every third person on earth consumes it every day in one form or other. In any system of rice cultivation, weeds are the major biotic constraint that causes yield reduction ranging from 15-90%. Globally, actual yield losses due to pests have been estimated at 40% out of which weeds account for 32%. Out of the losses due to various biotic stresses, weeds alone accounts for nearly one third of the total losses. Thus, weed control is mandatory for bettering rice productivity under any system of rice cultivation. Efficacy of different doses of pyrazosulfuron-ethyl against weeds of lowland rice was carried out during the *Kharif* season. The experiment was laid out in factorial randomized block design (FRBD) with twelve treatments and three replications. The major dominant weeds associated were *Monochoria vaginalis*, *Ludwigia parviflora* as broad-leaved weeds; *Scripus juncooides*, *Cyperus difformis* as sedges and *Echinochloa colona*, *E. crusgalli* as grasses. The experiment comprises of four doses of pyrazosulfuron-ethyl, viz. 0, 15, 25 and 35g a.i./ha. The herbicidal treatments were remarkably superior than the control (0g a.i./ha). It was found that pyrazosulfuron-ethyl effectively controlled broad-leaved weeds and sedges at all doses and grasses weeds to some extent. Pyrazosulfuron-ethyl at 35g a.i./ha applied as pre-emergence (3 DAS/T) was recorded to be most effective in suppressing the dominant weeds found in the experimental field with lowest total weed density and total dry weight of weeds. Among the different levels, highest weed control efficiency recorded was 87.86% with pyrazosulfuron-ethyl at 35ga.i./ha and yielded maximum grain yield of 3.686 t/ha.

Keywords:Pyrazosulfuron-ethyl, weeds, weed density, weed dry weight, herbicidal treatment

GENETIC DIVERGENCE ANALYSIS FOR INDIGENOUS RICE (*Oryza sativa* L.) GENOTYPES OF MANIPUR

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The present investigation was carried out with forty indigenous rice genotypes to investigate the nature and magnitude of genetic divergence during *Kharif*, 2019. The analysis of variance showed significant differences for all the characters studied among the genotypes. By using Tocher's method the genotypes were classified into fourteen clusters. Maximum number of 13, 6, 6 genotypes were grouped in cluster I cluster II and III respectively. Cluster IV to VII each had 2 rice genotypes whereas clusters VIII to XIV each consisted of single genotypes. The highest inter-cluster distance was observed between cluster VII and XIV (5211.59) followed by cluster VII and XIII (5093.68) indicates wider genetic variation between the genotypes whereas lowest distance

was recorded between cluster X and XI (655.72) specifies less genetic variation between genotypes. Intra-cluster distance was found maximum in cluster VII (626.73) showing variability within the cluster, while zero intra-cluster distance was observed in cluster VIII to XIV due to presence of single genotype in each cluster. Highest cluster mean value for grain yield per plant and was noted in cluster IV signifying desirability of genotypes in hybridization programme for improvement of different plant characters. Among the characters studied days to maturity (23.84%) contributed maximum towards divergence followed by biological yield per plant (14.03%) indicates these characters should be given more emphasis during selection of parents for hybridization programme.

Keywords: Cluster Distance, Genetic Diversity, Rice Genotypes, Yield.

EFFECT OF SOME PLANT GROWTH REGULATORS ON GROWTH, YIELD AND QUALITY OF BROCCOLI (*Brassica oleracea* L. Var. *Italica*plenk) CV. SAKI

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The experiment was conducted at RAKVK, Nimpith, South 24 Parganas, West Bengal, during rabi season (November-February) 2016-2017. To study the response of Broccoli cv. Saki by foliar application of PGRs. The treatment consisted of three levels of Gibberellin (30, 60, 90 ppm), three levels of NAA (40, 80, 120 ppm), three levels of Ethrel (50, 100, 150 ppm) and control. Altogether there were 9 treatments and control. Each treatment was replicated thrice in Randomized Block Design. Foliar application of aqueous solution of synthetic plant hormone at 28 and 45 DAT of seedling. It was noticed that at 60DAT, foliar application of 120 ppm of NAA recorded maximum plant height (66.55cm) and minimum with the treatment 150 ppm and 100 ppm Ethrel (61.33 cm& 61.44), maximum plant spread (85.73 cm) and minimum @50 ppm Ethrel (81.53 cm), foliar application of 60 ppm of GA3 recorded maximum number of leaves per plant (24.30) and minimum recorded with 50 ppm Ethrel (21.33), maximum stem diameter at the middle of the plant (3.54 cm) and lowest value of stem diameter was recorded with control (2.86 cm), maximum leaf length with GA3 30 ppm (18.40cm) and lowest value recorded with control (16.02 cm), maximum leaf area with NAA 80 ppm (79.53sqcm) and minimum with control, maximum head diameter was recorded with application of 120 ppm NAA (22.77 cm) and minimum recorded with control, maximum fresh head weight as well as total yield was recorded with NAA 120 ppm (480.43 g and 237.25 q/ha respectively) than the other treatments and control. Therefore, from the results of the present investigation it can be suggested that the foliar application of 120 ppm NAA, 60 ppm GA3 and 80 ppm NAA could give the best result for the vegetative growth, yield parameter and qualitative parameters for broccoli.

Key words: Broccoli, Ethrel, Foliar spray, GA3, NAA

IDENTIFICATION AND *IN SILICO* MOLECULAR CHARACTERIZATION OF β -GLUCOSIDASE GENE FROM SEEDS OF *Sechium edule* (JACQ.)SWARTZ

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β -glucosidase enzyme has the ability to cleave β -glycosidic bonds present in oligosaccharides and glycoconjugates. These enzymes are known to be present across all domains of living organism and play important roles in many biological processes like cell wall fortification, activation of hormones, plant defense mechanism etc. In the present study, a β -glucosidase enzyme identified from seeds of *Sechium edule* was identified and characterized in having probable antifungal activity using in silico tools. Full length β -glucosidase gene was identified using gene specific primers and validated by sequencing and sequence analysis. Further, a homology model (SeBG) was generated using a β -glucosidase crystal structure from *Oryza sativa* (PDB ID: 3PTK) as template. In silico structural binding studies on putative β -glucosidase protein revealed a stable and strong interaction indicative of higher GOLD fitness score with the substrates: p-nitrophenyl-b-D-glucopyranoside (pNPG), laminarin, chitotriose, N-acetylglucosamine and N-acetylmuramic acid suggesting its possible role in broad spectrum antifungal and antimicrobial activity. Molecular simulation studies of the putative protein showed very little variation in the stability of the protein with respect to its backbone. Validation of the antifungal activity was done by assessing the *in vitro* enzymatic activity against p-nitrophenyl-b-D-glucopyranoside (pNPG) and laminarin. The broad spectrum activity of the protein shown in our result indicates SeBG as a promising biocontrol agent against phytopathogens.

Keywords: β -glucosidase, *In Silico*, docking, pNPG, Laminarin, *Sechium edule*.

IMPACT OF CROP RESIDUE INCORPORATION AND OMISSION OF NUTRIENTS ON SOIL C: N RATIO

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An experiment was conducted at Research Farm, Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Kanke, Ranchi, Jharkhand during *Kharif* and *Rabi* seasons during 2016-17 and 2017-18. To assess the impact of incorporation of crop residues and omission of nutrients to the soil C:N ratio during the different growth stages of maize and wheat crops. The two years results showed that the incorporation of crop residues significantly affected C:N ratio during all three growth stages of maize. Crop residue incorporation being recorded 5.56, 3.40 and 22.29 per cent significantly lower C:N ratio compared to without crop residue incorporated treatment, at V_4 , V_{10} and after harvest stage, respectively in surface soil. Under omission of nitrogenous fertilizers (-N) recorded 61.09, 37.05 and 50.99 per cent in surface soil significantly higher C:N ratio compared to minimum observed under NPK i.e., 8.79:1, 10.04:1 and 16.24:1, at V_4 , V_{10} and after harvest stage, respectively. Similarly in wheat, the interaction, crop residue x nutrient combination showed a significant and positive effect on C:N ratio at CRI and PI stage, found highest values under omission of N (-N) i.e., 18.82:1 and 29.34:1, with and without incorporation of crop residue, respectively. At sub surface soil the status of C:N ratio was recorded slightly higher than surface soil sample, although, incorporation of crop residues in all growth stages of maize and wheat crops. Crop residues with low N and high C:N ratio such as maize and wheat can be incorporated into soil for faster C and N mineralization, thereby helping to manage high volumes of residues under conservation agriculture-based practices in India.

Key words: Crop residues, Omission of nutrients, Soil C:N ratio, growth stages, maize, wheat.

LIGHT MANAGEMENT STRATEGIES FOR COMMERCIAL HORTICULTURE

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Light is radiant energy, usually referring to electromagnetic radiation. It plays a major role in the growth and development of plants in various physiological and morphological aspects. The parts of light which plants can sense is called as Photosynthetically Active Radiation (PAR). Sensing the light by plants is possible by photoreceptor proteins *i.e.*, phytochrome and cryptochrome which absorb red and blue wavelengths of visible spectrum respectively that operate many functions of plants. Meanwhile, there are many problems regarding the light availability in both fields and under protected cultivation due to wide range of reasons. To overcome these problems there are some new approaches for light quality and intensity manipulation *viz.*, photo-selective nets, use of reflecting ground films, LED light technology etc. Thus, artificial light management strategies can be used for improving quality and yield of various horticultural crops (Folta and Childers, 2008)

Keywords: Plants, Light energy, growth, development

CROSS-TALK BETWEEN SIGNALING PATHWAYS IN PLANTS UNDER BIOTIC STRESSES

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Plant cell possesses several pathways mechanisms for receiving signals and thus shows appropriate response against those signals. Response of plant cell is very specific for a specific signal for which there are different pathways. The important thing is that there are interactions between pathways, known as cross-talk that function for several reasons like to integrate different signals, to produce a variety of responses for a signal, to show complex signaling behaviours for signals etc. Cross-talk is not stage specific, thus it can occur at any growth stage of plant. The connection between plant defense mechanisms and hormonal signaling pathways could be attributed to the key signaling regulators salicylic acid (SA), jasmonic acid (JA) and ethylene (ET) which have been seen to affect each other's pathways, either positively or negatively. Also the response by these regulators depends on the type of organism that interacts with the host/plant species. In many cases, host plants when infected by microbial pathogens and attacked by herbivorous insects are found to be associated with enhanced production of these hormones along with concomitant activation of distinct sets of defense-related genes depending on the quantity, composition and timing of the signal. SA is generally involved in the activation of defense response against biotrophic and hemi-biotrophic pathogens, whereas, JA and ET are responsible for defense against necrotrophic pathogens and herbivorous insects. Strong antagonistic effect of SA on methyl jasmonate (MeJA)-induced expression of JA-responsive marker genes reported in *Arabidopsis*. Various experiments conclude that pathogen-induced SA can negatively affect JA signaling but during multitrophic interactions, the SA pathway can be prioritized over the JA pathway. However, positive interaction

between JA and ET was reported in various studies in terms of activation of defense-related genes. Complex relationship between SA and ET was reported in various studies. It can be concluded that future experiments should be carried out with the aim of filling the gap in proper understanding of these pathways and their interactions, through adoption of genetic, molecular and biochemical approaches.

Key words: Cross-talk, biotrophic, hemi-biotrophic and necrotrophic pathogens, defense-related genes.

CARBON-DIOXIDE MITIGATION POTENTIALITY OF VARIOUS WOODY TREES

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Woody long-lived trees sequester carbon by capturing carbon dioxide from the atmosphere and transforming it into biomass through photosynthesis. Sequestered carbon is then accumulated in the form of biomass, deadwood, litter and in forest soils. Release of carbon from forest ecosystems results from natural processes (respiration and oxidation) as well as deliberate or unintended results of human activities (i.e. harvesting, fires, deforestation). The contribution of forests to carbon cycles has to be evaluated taking also into account the use of harvested wood, e.g. wood products storing carbon for a certain period of time, or energy generation releasing carbon in the atmosphere. In cases where the net balance of carbon emissions by forests is negative, i.e. carbon sequestration prevails; forests contribute to mitigating carbon emissions by acting as both a carbon reservoir and a tool to sequester additional carbon. In cases when the net balance of carbon emissions is positive, forests contribute to enhancing greenhouse effect and climate change. From this point of view, it is crucial to estimate the tree species superior for atmospheric carbon-dioxide (CO₂) mitigation. So, current research was undertaken to determine CO₂ mitigation ability of two forest tree species (Kadamba and Simarouba) and one horticultural tree species (Litchi). All trees were 13-year-old and several intercrops were grown along with trees. Huge potentiality of atmospheric CO₂ absorption recorded in all tree systems.

Keywords: Carbon-dioxide mitigation, Woody tree, Forestry.

INCIDENCE OF INSECT-PESTS ON PULSES, CEREALS AND OIL SEEDS GROWN AS INTERCROP IN CASTOR IN SOUTH-WEST HARYANA

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An experiment on incidence of insect-pests on pulses, cereals and oilseeds as intercrop in castor was conducted at regional research station, Bawal, Haryana during Kharif 2019-20. In pulse moong beans, the mean percent damage due to incidence of insect pests was observed of hairy caterpillar (22%), thrips (10%), fleabeetle (2.5%), jassid (12%), whitefly (6%), aphid (5.6%) and spotted podborer (11%). The mean percent damage caused by insect-pests in castor was 10.25%, 8.65%, 5.5%, 4.75%, 11.20%, 10.26% and 3.45% by the incidence of semilooper, hairy caterpillar, tobacco caterpillar, capsule borer, jassid, thrips and whitefly respectively. The mean percent damage in oilseed sesame (til) due to the incidence of hairy caterpillar, jassid, whitefly and til hawk moth was 4.75%, 5.25%, 5.55% and 5.20% respectively. In cereal pearl millet, the mean percent damage due

to incidence of insect pests was 5.55% of white grub, 1.75% of hairy caterpillar and 2.5% of grey weevils. Maximum incidence of insect pests was observed in castor crop while minimum incidence was in the pearl millet of cereal crop.

Keywords: Intercrop, insect-pest, incidence, percent damage.

SCREENING OF RICE LINES FOR FERTILITY RESTORATION GENES

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In order to assess the efficiency of different molecular markers which are linked to fertility restorer genes *Rf3* and *Rf4*, 34 breeding lines were screened with the help of molecular markers. The breeding lines were crossed with 4 CMS lines in line × tester fashion. The SSR primer RM6100, RM1 and RM3148 linked to *Rf4* gene on chromosome 10 and the marker DDRM-RF3-10 linked to *Rf3* gene of chromosome 1 were used for identifying the restorer lines. Out of 136 hybrids, 16 cross combinations recorded complete fertility in the test cross nursery, as well as revealed the presence of both *Rf3* and *Rf4* genes through molecular screening. These lines may serve as potential restorers for obtaining heterotic rice hybrids. The markers thus evaluated can serve as useful tools for screening large number of breeding lines to know about their fertility restoration behaviour in a short period of time. The pollen fertility under field conditions varied from 1.7 percent to 96.31 percent, whereas the spikelet fertility ranged from 1.48 percent to 92.44 percent. Out of 136 cross combinations, 43 were found to show more than 80 percent and 75 percent pollen fertility and spikelet fertility, respectively. The pollen parents of these hybrids were classified as stable fertility restorers for the respective CMS lines. Most of the test crosses revealed significant levels of heterosis (commercial heterosis, mid parent heterosis and better parent heterosis) for most of the traits studied. SKUA-7A × RL-3 and SKUA-11A × RL-5 showed desirable level of heterosis for most of the yield traits as well as desirable SCA effect. Among the female lines, SKUA-7A was found to be the best combiner for most of the traits. Among the pollen parents RL-1, RL-2, RL-11, SKUA-497, SKUA-494, SKUA-496 and SKUA-420 were found to be good general combiners for most of the traits.

Key words: Hybrid rice, Restorer lines, *Rf3*, *Rf4*, molecular markers

BIOASSAY OF *Bacillus thuringiensis* var. *Kurstaki* AGAINST OKRA SHOOT AND FRUIT BORER *EARIAS VITTELLA* FABRICIUS

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A bioassay with *Bacillus thuringiensis* var. *kurstaki* (Halt 5% WP) against five days old larvae of *Eariasvittella* Fab. was carried out at JAU, Junagadh. Seven concentrations viz., 25, 50, 100, 200, 400, 800 and 1600 µg/ml incorporated in the artificial diet. The larval mortality initiated from 2nd day and increased fast reached at maximum (38.16 to 99.73%) on 4th day after ingestion of the diet. The potency of the higher concentrations 800 µg/ml (98.68 % mortality) and 1600 µg/ml (99.73 % mortality) was statistically equal. The larval mortality decreased with decreased concentration and increased with increased time. The LC₅₀ was 46.67 % µg/ml/larva at 96 hr after ingestion of diet.

COMPARISONS OF QUANTITY AND QUALITY OF LIPIDS FOR TWO STRAINS OF *Chlorellavulgaris* AND THEIR EVALUATION FOR BIODIESEL PRODUCTIONS

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Renewable energy sources are the focus of this century. Economically and environmental friendly production of such energies are the challenges that limit their usages. Microalgae is one of the most promising renewable feedstocks. The objective of this work was to study the growth, lipid production and lipid profile of two different strains of *Chlorella vulgaris* BNL54, FKN45an isolates from Punjab and Kedarnath, India respectively, under optimized culture conditions. Under N limitation, biomass production of both isolates decreased by 5% and the amount of lipids increased by 11% in *C. vulgaris* BNL54.and 9 % FKN45 over control cultures. In *C. vulgaris* BNL54 under continuous illumination biomass increased by 7% while lipid content increased by 10%. The optimised condition for *C. vulgaris* FKN51 was pH 8.4 where the biomass and lipid content increased by 5% and 8% respectively. The fatty acid profile of lipids of the organism under optimized conditions also changed. Under continuous illumination *C. vulgaris* BNL54 showed saturated fatty acid (SFA) content were 69 %, monounsaturated fatty (MUFA) were 14% and polyunsaturated fatty acids (PUFA) were 16%; compared to control cultures with 42% SFA, 27% MUFA and 30% PUFA. While *C. vulgaris* FKN51 saturated fatty acid (SFA) content were 54 %, monounsaturated fatty (MUFA) were 26% and polyunsaturated fatty acids (PUFA) were 20% compared to control cultures with 39.3% SFA, 33% MUFA and 27.7% PUFA in medium with pH 8.4. This indicated fatty acid profile of lipids of both strains under optimized conditions were better from biodiesel production point of view.

BURL DISEASE ASSOCIATED WITH DIFFERENT CV. OF MANGO

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Mango (*Mangifera indica* L.) is a national fruit which belongs to family *Anacardiaceae*, and has good economic importance in Indian horticulture. During the whole life of mango fruits and plants suffers various types of disease and disorders. Among all the diseases and disorders ‘Mango burl’ has importance because it diminishes fruit quality and quantity. Burl is an uncontrolled outgrowth and tumor type swelling which occurs mainly on trunk but sometimes can be seen at whole plant. Burl size may differ from 5 to 10 cm and sometimes it varies from 1 meter or more in diameter. Generally, aged and woody plants have big size burl and have different types of colors, shapes and surface that may typically smooth to rough in texture. Burl does not kill the entire plant, but it badly impacts on the plant growth and fruits. The burl disease also infected plant morphology among which plant stem losses their natural function and results the transportation of water and food may disturb. During the anatomical studies, the section of burl infected stem showed extreme changes in its structure and composition where the axial elements like fibres, vessels, and parenchyma cells

totally lost its vertical alignment. The development of burl in mango plants shows positive correlation with some environmental factors in which disease get highly spread in humid area. Incidence of burl and fruit yield loss shows variations according to climatic conditions in different region of western part of India. The biochemical parameters like total soluble solid (TSS), total soluble sugar, reducing sugar, non-reducing sugar, ascorbic acid and acidity also fluctuate with burl disease. More than 20 major growing cv. of mango were found associated with burl disease and approx 10% of incidence was observed in the western part of India.

Keywords: Anatomy, Burl, Biochemical, Incidence

ZERO BUDGET NATURAL FARMING: A TOOL FOR DOUBLING FARMERS INCOME

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The zero budget natural farming refers to zero cost of production of all crops, without using chemical fertilizers and pesticide. ZBNF is low input and climate resilient farming that inspires farmers by using naturally available byproducts in the farm like cowdung, cow urine can be used as manure for crop production. Mr. Subhash Palekar founded this model and he was awarded Padmashri. The states implementing zero budget natural farming are Haryana, Himachal Pradesh, Karnataka, Andhra Pradesh and Kerala. ZBNF helps in reducing input cost, labour wages, fragile ecosystem, large suicide of farmers, change in consumer preference towards food safety. The organization which promotes ZBNF are Karnataka Rajya Raitha Sangha, Ishaadhguru foundation, Sony India private limited, the art of living foundation. Four pillars of ZBNF are Bijamitra, Jiwamrita, Mulching and Waaphasa (soil aeration). The drawbacks of ZBNF are there is no proper platform to sell the products which requires most of the attention from Government and other related agencies. It is practiced only in few parts of India which can be enhanced by creating awareness to farmers by local leaders. ZBNF has been emerged as a farming model for small and marginal farmers to overcome farming distress and sustaining livelihood. It reduces farmers cost through eliminating chemical inputs and utilizing available byproducts in the field which in turn increases the income. This reduces the debts made by the farmers and hence reduces the suicide committed by them. Hence this farming model should be adopted and replicated in other states of India, this can be used as a tool to double the farmers income. **Key words:** Zero budget natural farming, Doubling farmers income, Organic farming.

FEASIBILITY TESTING OF POWER OPERATED SUGARCANE DETOPPER CUM DETRASHER

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Sugarcane is mainly cultivated for sugar production in the world and is an important cash crop of India. In Chhattisgarh sugarcane is cultivated in 0.30 lakh hectare and the productivity is 41.6 ton/ha. It involves less risk and farmers are assured upto some extent about return in adverse

condition. Detrashing is the removal of leaves and top from harvested cane stalk which is highly labour intensive operation. Hence use of mechanical detrasher is one of the best option. It consist of mechanism of cane feeding, detopping and detrashing. The performance of the machine were evaluated by feeding different varieties of harvested cane. The trash left on cane after passing through the detrasher varied from 1.8 to 5.4%. Trash removal efficiency varied from 80.9 to 93.1% depending upon the variety. The output of detrasher was found 1.5t/h. There was saving of about 20% in cost of operation and 76% in labour requirement using the detrasher as compared to manual method.

Keywords ; Sugarcane, Detrashing, Detopping, Detrasher.

**ASSOCIATION OF CENTRE OF GRAVITY WITH VARIOUS LINEAR TYPE TRAITS
AT DIFFERENT PHYSIOLOGICAL STATUS OF SAHIWAL CATTLE**

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For present investigation, 86 purebred Sahiwal cattle of Bull Mother Experimental Farm and Government Cattle Breeding Farm located at the campus of College of Veterinary Science & Animal Husbandry, Anjora, Durg, Chhattisgarh were randomly divided into 5 groups on the basis of their physiological status viz. dry cows, early lactating cows, mid lactating cows, mid pregnant cows and late pregnant cows to measure the association between centre of gravity and linear type traits. All the linear type traits were measured and scored as per procedure described by International Committee for Animal Recording, 2018. During dry/non-pregnant stage, various significant correlations were observed for chest width/rear leg set-rear view (+ve; $p < 0.01$), rump angle (+ve; $p < 0.05$) and udder depth (-ve; $p < 0.01$). During early lactation, for udder depth (+ve; $p < 0.01$), Fore udder attachment (+ve; $p < 0.05$) and chest width (-ve; $p < 0.05$), during mid lactation for chest width (+ve; $p < 0.01$), rear leg set-rear view/rear udder height (-ve; $p < 0.05$) and during late pregnancy for chest width/udder cleft (+ve; $p < 0.05$). The results implicated the careful selection of animals with good conformation and proper floor management to prevent lameness due to varying positions of centre of gravity is important.

Keywords: Centre of gravity, linear type traits, floor management and lameness.

**REGENERATION PATTERN & FLORISTIC DIVERSITY ASSESSMENT IN SAL
FOREST OF CHHATTISARGH**

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The present paper deals with the regeneration and floristic diversity assessment/analysis in Chilpi range of Kawardha Forest Division, Chhattisgarh. A total of 9 species belonging to 6 families were recorded. Dipterocarpaceae family was represented highest individuals (>132) per ha followed by Combretaceae (35) and Lecythidaceae (5). *Shorea robusta* showed highest value of IVI (185.08) followed by *Terminalia tomentosa* (35.42) and *Anogeissus latifolia* (16.85). The quantitative features such as density and important value index (IVI) varied greatly among forest and different forest types. The diversity index of sapling layer with Shannon index (1.926) were higher than the tree species (1.531). It may be expected that plant density will become improve with upcoming sapling generation. Moreover this study creates a base to improve the management plan for the better growth of this natural Sal forest.

A REVIEW ON CLIMATE RESILIENCE PRACTICE DIRECT SEEDED RICE CULTIVATION AT BILASPUR DISTRICT CHHATTISGARH

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In Bilaspur district which belongs to Chhattisgarh plain Region transplanted rice is predominantly cultivated. Present investigation was done at Bilaspur District in the year 2017-18 and 2018-19. In Bilaspur district total Rice cultivated area is 217562 ha in which 3929 ha of area is under DSR technology. + application of pre emergence herbicide was in practice. Transplanting requires at least 25 ha-cm of water for puddling operation, which creates a dense clay layer in the sub-soil to prevent seepage losses. The crop requires about 130 ± 10 ha-cm of irrigation in addition to adoption of suitable variety and application of recommended dose of fertilizers to realize yield levels of about 6 ± 2 t/ha. Generally, about 40% of all irrigation water goes to paddy cultivation in the region. It is estimated that flooded rice fields produce about 10% of global methane emissions. Also, injudicious use of nitrogenous fertilizers is a common feature in paddy cultivation which is a source of nitrous oxide emissions. In Punjab, farmers generally take up transplanting of coarse rice. The current practice of excessive exploitation of ground water has led to a decline in the quality of natural resources i.e. land and water. Direct seeding of drought tolerant varieties of rice in dry soil is done in June with pre-emergence herbicide application (pendimethalin 1 kg/ha) under sufficient soil moisture conditions followed by a post-emergence herbicide application (bispyribac sodium 25g/ha) at 25-35 days after sowing or hand weeding at 35-45 days after sowing to effectively manage weed problem. Direct seeding in moist field with receipt of rains in June or by using ground water along with the application of pre-emergence herbicide is another option attempted. Control of weeds by use of glyphosate followed by zero till direct seeding of rice after one day of herbicide use is also practiced. In Bihar, direct seeding of medium duration varieties (125 days) can be done during second fortnight of July in midlands followed by a post-emergence herbicide application. In uplands, direct seeding of rice can be taken up with the onset of monsoon rains. Direct seeding of rice is done with a zero till drill. The quantity of seed required is 20-25 kg/ha compared to transplanted paddy which required 60-80 kg/ha. Benefit: cost ratio was higher in the Direct Seeded Rice method (2.49) compared to 1.78 in transplanted paddy and net income was up by Rs 12700/ha (32% higher as compare to transplanted rice).

Keywords: Paddy, Herbicide, Pre emergence and Post emergence.

DEVELOPMENT OF POWER OPERATED PADDY SEEDER FOR DRY AND WET SEEDING

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Rice is one of the most important crops in India with a total area of 44 Mha and a production of 110 million tonnes. The major constraints in manually transplanted paddy cultivation are non-availability of labour on time, especially during peak periods of sowing and need of large quantity of water. Mechanical transplanter could not be made widely popular because of higher cost, poor traction and sinkage. Direct seeded rice is becoming popular in India due to severe shortage of water and labour

and almost comparable yield. There is no single machine available for direct seeding of rice in both dry and wet condition.

It is a single wheel, 8-row riding type machine fitted with a 2.94 kW single cylinder, air cooled diesel engine which powers the forward movement of the driving wheel and rotary motion of metering mechanism. The drive wheel receives power through V-belt, cone clutch and gear box. Gear box for ground wheel comprises three sets of spur gear. The input shaft of gear rotates at speed of 1300 rpm and then according to shifting of gear lever it is reduces up to 185 rpm. A universal shaft from the gear box provides power to the sets of bevel and spur gear box and from then power is transmit to input shaft of gear box of metering mechanism as 468 rpm and then finally reduces up to 20.51 rpm to the cup type metering mechanism through chain sprocket assembly mounted over the float. The performance evaluation of a power operated paddy seeder was done with the pre-germinated paddy seed and dry seed under laboratory and field test.

Engine of paddy seeder 2.43kW (4 hp) revolves at speed of 2600 rpm which reduces as 90 rpm to the metering shaft and 21 rpm to the driving wheel through reduction unit. The fuel consumption varied between 2.57 to 2.83 l/ha with an average of 2.68 l/ha in dry seeding condition and 2.78 to 2.98 l/ha with an average of 2.83 l/ha in wet condition. The effective field capacity of machine is 0.23-0.25 ha/h. The field efficiency of paddy seeder in dry condition was 77.67 % and in wet condition it is 71.88 %.

Keywords: Power operated paddy seeder, metering mechanism, power transmission,

PRECISION AGRICULTURE IN INDIA: OPPORTUNITIES AND CHALLENGES

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Precision agriculture is based on information technology, which enables the producer to collect information and data for better decision making. The concept of precision agriculture offers the promise of increasing productivity while decreasing production cost and minimizing environmental impacts. Precision Agriculture is doing the right thing, at the right place, at the right time and knowing the right thing to do may involve all kinds of high tech equipments and fancy statistics or other analysis. Precision agriculture is also referred to as Satellite Farming or Site Specific Crop Management (SSCM) and it is one of the latest concept based approaches to farming which focuses on the important aspect of inter-field and intra-field variability for growing crops. One of the important aspects of Precision Farming is to develop and design a highly responsive DSS (Decision Support System) which will help in the economic utilization of inputs and at the same time maximizing the output. Precision agriculture offers the potential to automate and simplify the collection and analysis of information and it allows management decisions to be made and quickly implemented on small areas within larger fields. Precision agriculture tools such as GIS, GPS, etc., are used to control zone inputs and the exact location can be identified with the help of one of the main precision farming technology of Global Positioning System (GPS), while application on the exact location can be made with the help of advanced equipments available. In order to collect and utilize information effectively, it is important for anyone considering precision farming to be familiar with the modern technological tools available. The opportunity exists to show producers how changing production practices will not place crops at risk and produce positive economic and environmental benefits. Precision Agriculture gives farmers the ability to use crop inputs more effectively including fertilizers, pesticides, tillage and irrigation water and more effective use of

inputs means greater crop yield or quality, without polluting the environment. The success of Precision Agriculture depends largely on how well and how quickly the knowledge needed to guide the new technologies can be found.

Keywords: Precision agriculture, Opportunities, Challenges, Farmers, Benefits

AGROCHEMICALS AFFECTING SOIL MICROBIOTA

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The World Health Organization (WHO) states that in developing nations, there are three million cases of agrochemical poisoning. The prolonged intensive and indiscriminate use of agrochemicals adversely affected the soil biodiversity, agricultural sustainability, and food safety, bringing in long-term harmful effects on nutritional security, human and animal health. Most of the agrochemicals negatively affect soil microbial functions and biochemical processes. The alteration in diversity and composition of the beneficial microbial community can be unfavourable to plant growth and development either by reducing nutrient availability or by increasing disease incidence. Currently, there is a need for qualitative, innovative, and demand-driven research in soil science, especially in developing countries for facilitating of high-quality eco-friendly research by creating a conducive and trustworthy work atmosphere, thereby rewarding productivity and merits. Soil receives the bulk of complex agrochemical compounds, several of which are poisonous to the activity of non-target beneficial soil micro-organisms. More than 95% of the applied herbicides and 98% of insecticides reach non-target soil micro-organisms than their target pest, as they are sprayed proportionately across the entire field, irrespective of the affected areas. Hence, of the total quantity of applied pesticides, about 0.1% reaches the target organisms while the remaining quantity pollutes the soil and environment. This indiscriminate use of pesticides not only disturbs the soil biodiversity but also adversely affects soil microcosms comprising of soil micro-fauna in field communities and soil ecosystem. Large quantities of pesticides reaching to the soil have a direct effect on soil microbiota, which is a biological indicator of soil fertility influencing plant growth and development. Similarly, several studies have reported the impact of numerous pesticides on subduing soil enzyme activity(s) which affects the nutrient status of soil and include hydrolyzes, nitrate reductase, urease, oxidoreductases, nitrogenase, and dehydrogenase activities.

Keywords: Agro, Chemical, Micro agent and Microorganism

NURSERY: A PROSPECTIVE AGRO-ENTERPRISE

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The demand for high quality planting material is steadily increasing there is need of setting up plant nurseries by small and marginal farmers as well as by gardeners and farmhouse owners. Also, there is profound scope for starting the small nurseries, which will serve to augment the income of needy section of rural society. A nursery is a starting point for successful production. Nursery has emerged in this country as an important sector for diversification of agriculture with view to improve economic condition of farming community. It has established its credibility through increased productivity, generating employment for rural and urban people and enhancing export to a

considerable level. The history of civilization is rich with verses pertaining to agriculture. Almost all of them candidly connote the nature of agriculture as a food obtaining activity and nothing more, but with the advent of civilization, agriculture has grown in length and breadth. It's now a diversified activity. The demand of time has transformed agriculture from a subsistence-tool to an economic activity. It has become an enterprise now. The rapid growth of market economy has expedited the commercialization of agriculture sector which is gradually attaining the status of an enterprise. Nursery raising is one of the highly economic enterprise in horticulture sector. The nursery management gained status of commercial venture as the demand for high quality planting material is steadily increasing due to interest in vegetable gardening, fruit tree cultivation, social forestry, agro-forestry and plantation crops.

Keywords: Agro, Forestry, Nursery and Management.

RECENT TRENDS IN AGRICULTURAL EXTENSION

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Extension is a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their standard of living and lifting social and educational standards. The extension system of India has witnessed paradigm shift from 'production led' to 'farmers led' system which in turn has transformed the researches in extension. (Girish, 2017). Effective extension involves adequate and timely access by farmers to relevant advice, with appropriate incentives to adopt the new technology if it suits their socioeconomic and agroecological circumstances. Critical to adoption are the availability of improved technology, access to modern inputs and resources, and profitability at an acceptable level of risk. Farmers get information from many sources. Public extension is one source, but not necessarily the most efficient. Thus, although extension can improve the productive efficiency of the agricultural sector, the virtues and limitations of alternative mechanisms need to be considered in assessing the cost-effectiveness of delivering information. The modern extension system includes

Keywords: Agriculture, Extension, Ecology and Education

STUDIES ON PHYSICO-CHEMICAL EVALUATION OF TAMARIND (TAMARINDUS INDICA L.) GENOTYPES PREVAILING IN BASTAR REGION OF CHHATTISGARH ON MICRO NUTRIENT STATUS OF TAMARIND SEED

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The present investigation entitled "Studies on physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in Bastar region of Chhattisgarh" was carried out in the laboratory, Department of Horticulture, College of Agriculture, IGAU, Raipur (C.G.) during the year 2004-05 and 2005-06. The study was carried out with 16 treatments (genotypes) consist of ripe fruits collected from selected trees of tamarind exist in Tokapal and Jagdalpur block of Bastar district (C.G.) under Randomized Block Design with three replications. Higher K content of seed was observed in IGTAM-15 (523.83 mg/100g) and minimum level was observed in IGTAM-10 (263.25

mg/100g). Maximum Na content of seed was noticed in IGTAM-15 (27.62 mg/100g) minimum was recorded in IGTAM-7 (15.15 mg/100g). Maximum Zn content of seed was recorded in IGTAM-15 (1.82 mg/100g) while minimum content was recorded in IGTAM-16 (0.41 mg/100g).

Keywords: Tamarind, iron, magnesium, copper, zinc and sodium

VERMICOMPOST: AN IDEAL WASTE FOR SOIL FERTILITY

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Vermicomposting is a mesophilic bio oxidative process in which detritivorous earthworm interacts with microbes and soil invertebrates within decomposer community, strongly affecting decomposition process, accelerating the stabilization of organic matter and enhancing its physical and biochemical properties. Vermicompost is an odourless, stabilized, dark brown, finely divided peat-like material with a low C: N ratio, high porosity and high water-holding capacity bio product in which most nutrients are present in available forms for plant. Also called vermicasts as they are expelled as casts from the earthworm gut. Vermicompost contain nutrients such as nitrates, exchangeable phosphorus, soluble potassium, calcium, and magnesium in plant available forms and have large particular surface area that provides many microsites for microbial activity and for the strong retention of nutrients. The actions of the earthworms in this process are both physical and biochemical. The physical actions include fragmentation, turnover and aeration. Whereas biochemical actions include nitrogen enrichment, enzymatic digestion, transport of inorganic and organic materials. Soil volume, microflora and fauna influenced by earthworms have been termed as drilosphere.

Keywords: Microflora, Vermi, Earthworms and C:N ratio.

BIOCONTROL AGENT AND CORRIVAL FOR PLANT DISEASES

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Biological control is defined as the reduction of inoculum density or disease producing activities of a pathogen or parasite in its active or dormant stage by one or more organisms accomplished either naturally or through manipulation of the host, environment, or by mass introduction of one or more antagonists. The fungus, *Trichoderma viride* is a bio control agent, mainly used for the control of root rot diseases of pulses and oil seeds in Chhattisgarh. *Trichoderma* is a very effective biological mean for plant disease management especially the soil born. It is a free-living fungus which is common in soil and root ecosystems. It is highly interactive in root, soil and foliar environments. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions and enzyme secretion.

Keywords: Biocontrol, Disease, root rot and Enzyme

**EFFECT OF DIFFERENT SOIL AND WATER CONSERVATION MEASURES
ON SOIL MOISTURE AND SOIL LOSS UNDER FINGER MILLET
CROPPING SYSTEM OF ALFISOLS**

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A Field experiment conducted to study effect of different soil and water conservation measures on soil moisture and soil loss under finger millet cropping system of *alfisol* at AICRP for Dryland Agriculture, UAS, GKVK, Bangalore. With varied slopes viz., 1.9 %, 2.24 % and 2.1 % showed significant variations in Soil moisture at all stages of crop and different depths. . At 15-30 cm, depth, contour trenches made at 10 m interval (slope 1.7 per cent) recorded significantly higher moisture (12.50, 18.80 per cent) during August, (13.86, 25.40 per cent) during September, (24.3, 23.9 per cent) during October and (5.12, 6.23 per cent) during November at intervals of 15 and 30 day, respectively compared to other treatments. However lower soil moisture (8.14, 12.74 per cent) was in control (2.24 per cent slope). In the month of August (10.33, 18.20 per cent), during September, (20.92, 16.10 per cent), during October and (3.89, 4.98 per cent) during November. With respect to soil loss minimum (3011.67 kg ha⁻¹) was observed in contour trench with 1.7 per cent slope for the entire runoff causing rainfall compared to all other treatments while it was maximum (4218 kg ha⁻¹) in Plot with (2.24 per cent slope). Thus contour trenches made at 10 m interval proved to be effective measure.

Key words: Conservation, Finger millet, Soil, Water.

**A STUDY ON THE PERFORMNACE OF THE LEAD BANK SCHEME IN BARGARH
DISTRICT OF ODISHA**

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The Economy of India is Agrarian , Planned Mixed and Developing in nature, it serves as a fuel of growth and development of the country, a number of Innovative , Novel and Planed Schemes and programmes have been designed and implemented, among them lead bank scheme is one of the most important scheme which was started in 1969 plays a very important role in the Indian economy, the present study pointed out the role of Lead Bank scheme in the development of the economy especially in backward areas of the country, the main function of the lead bank is to make efforts for the coordination among all Other Banks and Financial Institutions and Other Development Agencies for bringing over all development of the District . From the study it has been concluded that it is the sole responsibility of the Lead Bank to open more number of branches in the remote village areas. The scheme is successful in distribution of credit in the rural area and it is also successful in making coordination among different agencies for the development of the country.

Key words: - Lead Bank Scheme, Credit plan, Branch expansion, Bargarh District

FLOWER-VISITING INSECT POLLINATORS OF MUSTARD (*Brassica napus*) IN JAMMU REGION

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The present studies on Flower-Visiting Insect Pollinators of Mustard (*Brassica napus*) in Jammu region, India were conducted at Entomological Research farm, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. The blooming crop of the Mustard was visited by 15 species of insects belonging to 4 orders and 7 families of class insects. Hymenopterans were the most dominant visitors constituting (87.48, 88.18) per cent of the insect pollinators, followed by other insect pollinators (12.52, 11.82%) in 2014-15 and 2015-16 respectively. Among the hymenopterans species, *Apis mellifera* L. was highest in number (28.09, 28.31%) of the visitors of mustard flowers, followed by *Apis cerana* F. (25.10, 25.48%), *Apis dorsata* F. (18.00, 18.09%), *Apis florea* F. (8.53, 7.90%), *Xylocopa fenestrata* (5.55, 5.71 %) and other insect pollinators (12.52, 11.82%). of the total flower visiting insect pollinators in 2014-15 and 2015-16 respectively. The foraging activity of honeybees increased with temperature and sunshine and decreased with relative humidity, wind speed and rainfall. However, the species differences in the population dynamics of bees were evident as of all the honey bees *Apis mellifera* was most abundant followed by *A. cerana* > *A. dorsata* > *A. florea* > *X. fenestrata*. The foraging population of *Apis mellifera* was highly significant and positively correlated with maximum temperature and sunshine hours and negatively with relative humidity in the evening but was non-significant with minimum temperature, relative humidity in the morning, rainfall and wind speed. Same trend was observed for *Apis florea*. However, the foraging population of *Apis cerana* was significant and positively correlated with maximum temperature and minimum temperature but was non-significant with relative humidity in the morning and evening, rainfall, sunshine hours and wind speed. Same trend was observed for *Apis dorsata* and other pollinator but other pollinator was highly significant and positively correlated with sunshine hours. In case of *Xylocopa fenestrata* was non-significant with all-weather parameters. This clearly reveals that all the four species of honeybees and other pollinators varied in their response to climatic conditions prevailing at a unit time.

Keywords: Mustard, insect pollinators, *Apis* spp., Weather condition.

STRIPE RUST SEVERITY AND INFECTION TYPES IN PARENTS AND HYBRIDS BY USING MODIFIED COBB'S SCALE AND FIELD RESPONSE SCALE IN WHEAT (*Triticum aestivum* L.)

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The present investigation was carried out with the objective of enhancement for stripe rust resistance in the adapted varieties of wheat grown under timely sown irrigated conditions. The material for the experiment consisted of six stripe rust resistant lines and three adapted varieties of wheat crossed in Line into Tester design during off season 2013 at Dalang Maidan, Lahaul Spiti, Himachal Pradesh. The F₁s were grown during *rabi* 2013 at Research Farm, Division of Plant

Breeding and Genetics, SKUAST Chatha, Jammu. Observations on the quantitative traits viz., plant height (cm), number of effective tillers, days to 50% flowering, spike length (cm), number of grains /spike, days to maturity and grain yield per plant were recorded. Observations on the disease severity were also recorded for the parents and crosses as per the Modified Cobbs scale. Heterosis studies reveal maximum desirable positive heterosis for grain yield in the cross IBWSN 1175 x PBW 550 (15.00 percent) followed by DWR 41 x PBW 550 (10.52 percent) IBWSN 1175 x RSP561 (05.00 percent) with a disease reaction ranging between resistant to trace type of resistant reaction. The cross IBWSN 1047 x PBW 550 carry both the *Yr* genes in combination shows resistant type of rust reaction but is poor yielding with a grain yield per plant of 12.0g. This cross can be carried further by backcrossing with high yielding adapted parent and if successful depicts the role of MAS in early generation screening.

Key words: Disease severity, Resistance, Rust reaction. Stripe rust

FUNCTIONAL PROPERTIES AND CHARACTERIZATION OF STARCH, FIBER AND PROTEIN FRACTIONS ISOLATED FROM BRAN OF COARSE, FINE AND SUPERFINE RICE (*Oryza sativa* L.) CULTIVARS

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Commercial rice bran contained moisture, ash, fat, fiber, protein and carbohydrates contents ranging from 8.8 – 12.9%, 8.5 – 8.9%, 19.2 – 23.0%, 7.7 – 11.0%, 13.4 – 14.1% and 34.7 – 38.8%, respectively. Rice bran of course, fine and superfine cultivars showed significant ($p \leq 0.05$) difference in moisture, fat, fiber and carbohydrate content. Lipase activity was inhibited to control the development of free fatty acids (FFAs) level in rice bran by altering temperature or chemical treatments. At -20°C , FFAs values remained stable during 40 days of storage period. Among chemical treatments, development of FFAs significantly decreased with increase in the acid treatment level and remained stable at 5% HCl level for 40 days. Defatted rice bran was used to isolate the starch, fiber and protein fractions. Bran starch fraction had lower starch content (71.51 – 75.69%, db) while higher ash content (15.96 – 19.58%, db) as compared to endosperm starch fraction. Apparent amylose content of bran starch fraction (0.41 – 0.87%) was significantly ($p \leq 0.05$) lower than endosperm starch fraction (6.15 – 10.25%). Physicochemical properties of bran starches fractions like swelling power, solubility index, syneresis and light transmittance were significantly ($p \leq 0.05$) different from the endosperm starches. Rice bran starch fractions possessed lower crystallinity and IR absorbance ratio of 1047/1022 cm^{-1} and 1022/995 cm^{-1} whereas higher transition parameters and enthalpy of gelatinization as compared to endosperm starch fractions. Bran starch granules were round in addition to polygonal shape having large number of small and compound granules (1.9 – 8.2 μm in size) with rough and cracked surfaces and in size. Starch from coarse rice cultivar had the smallest granules.

Chemical composition of rice bran fiber fraction (RBF_f) revealed that fiber content varied from 32.28 to 35.21% (db) and other components such as protein, ash and fat varied from 11.86 – 13.75%, 2.90 – 4.53% and 1.50 – 2.03% (db), respectively. The micronutrients in fiber fraction were copper (1.94 – 4.18 mg/100g), manganese (9.08 – 11.32 mg/100g), iron (16.06 – 22.54 mg/100g), zinc (4.62 – 6.08 mg/100g), magnesium (1050 – 2294 mg/100g), sodium (12.13 – 21.09 mg/100g) and potassium (528 – 979 mg/100g). Micronutrients content of rice bran fiber fractions varied significantly ($p \leq 0.05$) with cultivars. Bran fiber fractions from coarse, fine and superfine

rice cultivars showed non-significant ($p > 0.05$) difference in swelling capacity whereas, significant ($p \leq 0.05$) difference in bulk density, water binding capacity, oil binding capacity, emulsion capacity and cation exchange capacity.

Rice bran protein concentrates (RBPCs) had protein content in the range of 67.52 – 72.16% (db). Bran protein concentrate from superfine rice cultivar (SF-RBPC) had significantly ($p \leq 0.05$) lower protein content. Glutamic acid was the most abundant amino acid in all three RBPCs followed by aspartic acid in SF-RBPC whereas arginine and valine were the second most abundant amino acids in bran protein concentrate from coarse (C-RBPC) and fine (F-RBPC) rice cultivars, respectively. RBPCs showed similarities in polypeptide patterns having MW of 63.7 – 9.7 kDa. Secondary structure of RBPCs had high amount of β -sheet followed by β -turns, random coils and α -helix. Enthalpy of denaturation was high for F-RBPC. Protein solubility of RBPCs over the pH range of 2 – 12 significantly ($p \leq 0.05$) varied from 7.48 – 83.14%. F-RBPC showed significantly ($p \leq 0.05$) higher protein solubility at pH 2.0 and 12.0. Emulsion activity index was significantly ($p \leq 0.05$) higher at pH 9.0. SF-RBPC and C-RBPC had significantly ($p \leq 0.05$) higher emulsion activity index. Emulsion stability index was significantly ($p \leq 0.05$) higher at pH 5.0 and 9.0. C-RBPC exhibited higher emulsion stability index. Foaming capacity of RBPCs was significantly ($p \leq 0.05$) higher at pH 10.0 and lower at pH 4.0. F-RBPC exhibited significantly ($p \leq 0.05$) highest foaming capacity among all cultivars. Foaming stability of RBPCs over the time period of 180 min was significantly ($p \leq 0.05$) higher at pH 4.0 and 6.0 than at other pH. SF-RBPC and C-RBPC had significantly ($p \leq 0.05$) high foam stability at pH 6.0 but F-RBPC showed significantly ($p \leq 0.05$) high foaming stability at pH 4.0. SF-RBPC had significantly ($p \leq 0.05$) higher *in-vitro* digestibility followed by F-RBPC and C-RBPC. During digestion over the time period of 240 min, RBPC released free amino groups of 5.25 – 6.24 mMol/L. *In-vivo* studies revealed that protein efficiency ratio (PER) and corrected-PER values of test proteins varied from 1.80 – 2.15 and 1.92 – 2.30, respectively. Net protein utilization, true digestibility and biological value for casein were 85.55%, 95.48% and 89.59%, whereas for bran proteins were 69.81 – 78.89%, 86.51 – 92.55% and 80.64 – 86.46%, respectively. Net protein utilization for casein was significantly ($p \leq 0.05$) higher than test protein. True digestibility of F-RBPC and biological value of SF-RBPC and casein did not vary significantly ($p > 0.05$).

Proteins were hydrolyzed using optimum conditions to get low (~15 %), medium (~25 %) and high (~33 %) degree of hydrolysis. Surface hydrophobicity drastically decreased with increase in degree of hydrolysis. Free radical scavenging ability and reducing power of hydrolysates were significantly ($p \leq 0.05$) higher as compared to native and increased as the degree of hydrolysis increased. However, metal chelating activity of hydrolysates decreased with increasing degree of hydrolysis. Protein solubility of hydrolysates increased over the pH range of 2 – 12 as the degree of hydrolysis increased. Rice bran protein hydrolysates showed a significant ($p \leq 0.05$) decrease in emulsion activity index over the pH range of 3 – 9 except pH 5.0. However, emulsion stability index increased at low degree of hydrolysis and then decreased with further increase in degree of hydrolysis. Foaming capacity of hydrolysates also increased as compared to native whereas, it decreased with further increase in degree of hydrolysis.

DEVELOPMENT AND EVALUATION OF VALUE ADDED BANANA-GUAVA CHEESE

USING SOYA PROTEIN ISOLATE AND WHEY PROTEIN ISOLATE POWDERS

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The health awareness among the people of world is rising day by day and it leads to demand of food product that contains functional ingredients. Due to this demand and needs of people, protein rich banana-guava cheese was developed using soya protein isolate and whey protein isolate powder (2, 4 and 6%). Cheese variants supplemented with 2% soya protein isolate powder and 4% whey protein isolate powder were found most acceptable and selected for preparation and evaluation of protein rich banana-guava cheese. The cheese was developed using 40% banana and 60% guava pulp. The other ingredients include 70 g butter, 900 g sugar, 5 g salt and 4 g citric acid for one kg pulp. Blending pulp of two different fruits like banana and guava helps in improving the nutrition and overall acceptability of the product. The banana-guava cheese was evaluated for changes in chemical parameters at monthly interval for three months storage period. This product is very popular among children due to its excellent taste and flavour.

Key words: Banana, guava, protein rich and cheese

EFFECT OF INTRA ROW SPACING AND WEED MANAGEMENT IN COTTON

(*Gossypium hirsutum*L.) UNDER SOUTH GUJARAT CONDITIONS

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Field experiments were conducted at Instructional Farm, Navsari Agricultural University, Navsari (Gujarat) during kharif season of 2010-11 and 2011-12 to know the effect of intra row spacing and weed management in cotton under heavy rainfall zone of South Gujarat. Various growth and yield attributing characters of cotton were significantly affected due to different levels of spacing and weed management practices. Weed population at 20,40,60,90 DAS and at harvest and dry weight of total weeds at harvest were significantly lowest with wider spacing (S3) and markedly higher under weedy check (W1). Dry weight of weeds at harvest differed significantly in all the treatments and remained in W4< W3< W5< W6< W2< W7< W1 order of their significance.

AN APPROACH TOWARDS THE CONSERVATION AGRICULTURE IN INDIA USING BEST AGRONOMIC AND SOIL MANAGEMENT PRACTICES

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The chapter review had been made on the comparative study of conservation agriculture over conventional agriculture practices on ample of observation and results whenever amplification is made for any conventional agricultural practices from various corners of soil management, agronomical practices and economical concepts, it gives a ray of conservational agricultural which stabilizes and maintain equilibrium between biotic and abiotic components of disturbed ecosystem. Some of the sub-heads under this manuscript might be novel, but its associate practices had long been employed by the scientist, farmers and the reason for the adoption and non-adoption had been

advocated by the social-scientist from very long. Even though, there are few variables that regurlyexplains the adoption of conservational agriculture across the globe. Identifying such variables through further review we, finally promotes conservational agricultural practices not only it is liable but perhaps reasonable.

Key Words: Conservational Agriculture, Conventional Agriculture, Agronomic Management, Soil Management, Zero Budget Farming.

ADVANCES IN RESIDUE FREE CULTIVATION OF FRUIT CROPS

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From the past few years agricultural products such as mangoes, table grapes, okra, peanuts, curry leaves, chillies, shrimps, prawns, and tamarind have faced massive rejections and bans in the global markets such as the US, Vietnam, EU, Saudi Arabia, Japan and Bhutan due to the presence of high levels of chemical residues. Pesticide residue is a substance in food, feed, soil, water and air originating from the use of chemical pesticides including the specified degraded and converted products, metabolites, reaction products and impurities. Residue free fruit crops can be achieved through methods like Integrated Pest Management (IPM), Integrated Nutrient Management (INM) and precision farming. An eco-friendly alternative to these chemical pesticides can be bio-pesticides encompassing a broad array of microbial pesticides, bio-chemicals derived from micro-organisms and other natural sources, and other biotechnological processes involving the genetic incorporation of DNA into agricultural commodities, genome editing etc that confers protection against pest damage and reduce the usage of pesticides. Adoption of Machine Vision Systems in Precision Agriculture can effectively control pests. Therefore it is important to follow good agricultural practices for management of pesticide residues corresponding to the practice that leads to the maintenance of residue concentration below the MRL or at concentration that is legally permitted or recognized as acceptable on food, agricultural commodity, or animal feed.

Keywords: IPM, INM, Precision farming, Genome editing, MRL

DYNAMIC VISCO-ELASTIC BEHAVIOUR, GEL FORMING ABILITY OF PROTEINS AND HISTOLOGICAL CHANGES IN SHRIMP (*L. Vannamei*) MUSCLES DURING ICE STORAGE

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In the present investigation, dynamic viscoelastic behaviour and functional properties of proteins from white leg shrimp were assessed for 14 days in ice storage. Ca²⁺ ATPase activity of fresh myofibrillar protein (MFP) was 0.118 μ moles Pi/min./mg proteins which reduced significantly ($p < 0.05$) at the end of the storage. Increase gapping in myofibrils and changes in myosin banding pattern were clearly observed with progress of storage. Solubility of fresh MFP was 86.76 % which decreased to 77.06 % on 14th day of storage period. Apparent reduced viscosity of MFP registered 60 % reduction in the original value at the end of storage period. Emulsion capacity of MFP found

to be in increasing trend during storage period. Gel forming ability of white leg shrimp meat was very poor (80.62 g.cm) and reduced significantly ($p < 0.05$) on 6th day of storage. In the fresh condition, the value of storage modulus (G') propelled continuously and achieved maximum value (535.77 kPa) at 64.30 °C. The peak values of G' of white leg shrimp recorded a continuous decrease up to 4th day of storage and remained low compared to fresh meat. On the basis of chemical quality indices (TVBN and TMA), the shelf life of white leg shrimp remained 8 days in the ice storage.

Key words- White leg shrimp, Myofibrillar proteins, Dynamic viscoelastic behaviour, Ice storage

PHYSIOLOGICAL EMPHASES OF SOME RECENTLY DISCOVERED PLANT HORMONES

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Phytohormones like auxins, gibberellins, cytokinins, abscisic acid, ethylene, strigolactones, brassinosteroids, salicylic acid and triacontanol are quite well known plant hormones but recently many other plant hormones have been discovered and are pioneer approach to regulate plant growth, development and yield of crops in various perspectives. Jasmonates, peptides, polyamines, nitric oxide and karrikins are among those recently discovered plant hormones brought into focus through current research studies and applications on plant growth and yield productions. The importance of jasmonates on plants includes storage organ formation, induction of plant defenses against biotic (such as herbivores, pathogens) and abiotic (such as drought, ozone) stresses and growth inhibition in tissues such as roots and young shoots. The peptide hormones regulate plant growth and development and carry on signal transductions in response to regulating external and internal environment stimuli. Polyamines play important activities in plant growth and development including seed germination, tissue lignification, organogenesis, flowering, pollination, embryogenesis, fruit development, ripening, abscission, senescence, and stress responses. Nitric oxide (NO) is an important signalling molecule and found to play a crucial role in plant growth and development, starting from germination to flowering, ripening of fruit and senescence of organs, respiratory metabolism, as well as plant response to abiotic and biotic stresses. The progress in karrikins has stemmed from the structural similarity of strigolactones and as well as similar action of shoot branching. Most of the plant hormones do not independently affect the specific physiological activities; rather those work together either synergistically or antagonistically with other hormones and finally impact the plant growth and development.

Key words: Phytohormones, polyamines, peptides, karrikins, jasmonates, nitric oxide

DIVERSE ROLE OF BRASSINOSTEROIDS ON PLANT

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Steroids play an effective role as essential hormones in plants as well as in animals. Plants produce numerous steroids and sterols. Brassinolide (BL), a compound having structural similarity to animal steroid hormones, is the most bioactive form of the growth-promoting plant steroids termed as

brassinosteroids (BRs). These steroid phytohormones have fair role in plant growth and development, regulating diverse physiological processes such as embryogenesis and seed germination, cell elongation, cell division, photomorphogenesis and reproduction. Other important functions of BRs include enhancement or retardation of root growth, inducing growth of pollen tubes, unrolling of leaves, differentiation of xylem vessels, enhanced ethylene production, increased ATPase activity, enhancing protein synthesis, improving photosynthetic activity, and maintaining the balance of other endogenous phytohormones. Since their discovery more than four decades ago, extensive research on their mechanisms of action using biotechnological approaches, has helped find the BR biosynthetic pathway, identify their mode of function, signal transduction mechanism etc. Recent studies have discovered regulatory role of BRs on antioxidant enzymatic activities in plants like maize, mustard, radish, wheat, and rice. Thus, it can be concluded that BRs also possess role in reducing several abiotic and biotic stresses in plants. Still there are lack of understandings of their exact function and whether those are crop- and crop growth stage specific. Further studies with the help of molecular approach will fill these knowledge gaps and find out broad-spectrum role of BRs on plants.

Key words: BRs, physiological processes in plants, abiotic and biotic stress, molecular approach

APPLICATION OF DIFFERENT DOSES OF BENZYL ADENINE ON PLANT FRESH WEIGHT, PLANT DRY WEIGHT AND TEN-FLOWER FRESH WEIGHT OF *Tagetes erecta*

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An experiment was conducted at the instructional farm of the Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal to study the effect of benzyl adenine (BA) on production of African marigold cv. PusaNarangiGainda from November, 2016 to March, 2017. Twelve different levels of BA viz. T₁ =25 ppm, T₂ = 50 ppm, T₃ =75 ppm, T₄= 100 ppm, T₅= 125 ppm, T₆ = 150 ppm, T₇ = 175 ppm, T₈ = 200 ppm, T₉ = 225 ppm, T₁₀ = 250 ppm, T₁₁ = 275 ppm and T₁₂ = 300 ppm were applied on African marigold and their effects were compared to control (T₁₃) plants. Diverse effects of different concentrations of BA on African marigold were noticed on the parameters such as; fresh weight of plant (g), dry weight of plant (g) and ten-flower fresh weight (g), all of which data were taken at 70 DAS. It was found from the result that maximum fresh weight of the plants was obtained at T₆ (697.10 g) followed by T₇ (668.77 g) and T₅ (582.78 g) and minimum dry weight was obtained at T₁₃ (458.68 g). In terms of dry weight of the plants; maximum dry weight was recorded at T₆ (259.15 g) followed by T₇ (257.30 g) and T₈ (243.85 g) and minimum dry weight was recorded at T₁₁ (143.19 g). Fresh weight of ten flowers also varied with treatments; being recorded the highest in T₇ (87.42 g) followed by T₆ (75.34 g) and T₄ (71.32) gm, while the lowest in T₂ (58.36 g).

Key Words: - BA, *Tagetes erecta*, plant dry weight, plant fresh

CLIMATE CHANGE, ITS IMPACT ON AGRICULTURE AND MITIGATION STRATEGIES

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Population growth and climate change are the challenges of the 21st Century. Climate change is mainly caused by anthropogenic emissions of greenhouse gases (GHG: CO₂, CH₄, N₂O, HFC, PFC and SF₆), which accumulate in the earth's atmosphere and trap heat. It is a known fact that global temperature levels will rise anywhere between 2 - 5° over the next century. In developing countries like India, climate change could represent an additional stress on ecological and socio-economic systems that are already facing tremendous pressures due to rapid urbanization, industrialization and economic development. Climate change has had an effect on the monsoons too. India is heavily dependent on the monsoon to meet its agricultural and water needs, and also for protecting and propagating its rich biodiversity. Most of the simulation studies have shown a decreased in the duration and yield of crops as temperature increased in different parts of the India. Yields of both *kharif* and *rabi* crops decreased as temperature increased by 2⁰C; and increase resulted in 15-17 percent decrease in the grain yield of both crops, but beyond that the decrease was very high in wheat.. The nutritional quality of cereals and pulses may also be moderately affected which in turn will have consequences for our nutritional security. The loss in farm level net revenue may range between 9 per cent and 25 per cent for a temperature rise of 2-3.5⁰C climate change. The potential of organic agriculture in mitigating climate change depends on its ability to reduce emissions of GHGs, nitrous oxide and methane, increase soil carbon sequestration, and enhance effects of organic farming practices which favor the above two processes. Reduction of greenhouse gas emissions recent experiments results suggested that organic agriculture can significantly reduce GHG emissions. Both conventional and organic agriculture relies on solar and fossil energy for food production. Carbon sequestration in soils and plants is the only strategy that can remove carbon from the atmosphere and, over time, reduce atmospheric concentration of CO₂. This approach allows the enforcement of adopting new and improved farming practices aim at mitigating climate change. In addition, organic agriculture is highly adaptable to climate change and is also provides a high degree of diversity in the ecosystem.

Key words: Climate change, Mitigation, Green house gases, urbanization and industrialization.

EFFECT OF BROWN MANURING AND WEED MANAGEMENT PRACTICES TO ENHANCE THE WEED CONTROL EFFICIENCY AND PRODUCTIVITY IN RICE

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In Central India, rice is the important crop and occupies maximum area. However, the favourable environment for the growth of wide spectrum of weeds is one of the important reasons for reduction in crop productivity. Therefore, effective weed management approaches is essential for higher productivity in rice. Keeping this in view, an experiment was hypothesized during 2013-14 to find

out the efficacy of Sesbania brown manuring and weed management efficacy in suppression of weed dynamics and improvement of production and control efficiency under transplanted rice. The experiment was laid out in split plot design with four planting methods (Transplanted Rice (TPR), Transplanted Rice + brown manuring (Sesbania), Direct Seeded Rice (DSR) and Direct Seeded Rice + brown manuring (Sesbania) and in main plots and four treatments of weed management practices (weedy check, Bispyribac sodium 25 g ha⁻¹ + (Chlorimuron + metsulfuron) 4 g ha⁻¹, Bispyribac sodium 25 g ha⁻¹ + (Chlorimuron + metsulfuron) 4 g ha⁻¹ followed by one hand weeding at 45 days after sowing/days after transplanting (DAS/DAT) and two hand weeding at 20 DAS/DAT and 45 DAS/DAT) in sub-plots with three replication. The highest weed control efficiency was found in the transplanted rice with brown manuring (TPR + BM) treatment at 30, 60, 90 DAS and at harvest stage, respectively and lowest was recorded in direct seeded rice. Among weed management practices, two hand weeding at 20 DAS/DAT and 45 DAS/DAT caused significantly higher reduction in the weed dynamics and weed dry weight of weeds were recorded at 30, 60, 90 DAS and at harvest and also recorded the highest weed control efficiency followed with application of Bispyribac sodium 25 g ha⁻¹ + (Chlorimuron + metsulfuron) 4 g ha⁻¹ followed by one hand weeding at 45 DAS/DAT amongst the weed management treatments. TPR produced the maximum rice grain yields. On an average of both years, weed control treatments produced 21 to 43% higher rice grain yield than the weedy plots. TPR + BM (Sesbania) and two hand weeding at 20 DAS/DAT and 45 DAS/DAT significantly increased the growth and yield attributes and recorded highest grain yield. TPR with BM significantly fetched higher net returns (Rs 52,924 ha⁻¹ followed by DSR + BM (Rs 46644 ha⁻¹). Whereas, highest B: C ratio (3.5) was found under DSR + BM which was at par with TPR with BM (3.3). Two hand weeding at 20 and 45 DAS/DAT significantly fetched higher net returns (Rs 54893/ha) and B: C ratio (3.5).

Keywords: Brown manuring, rice productivity, seeding techniques, weed control efficiency and weed management

STUDY ON YIELD OF KHARIF VEGETABLE CROPS UNDER POPLAR BASED AGROFORESTRY SYSTEM IN SUBTROPICS OF JAMMU

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A two years trial was conducted to study the performance of different vegetables under poplar based agroforestry system in subtropics of Jammu (J&K) at agroforestry research farm, Chatha of Sher-e-Kashmir University of agricultural sciences and technology of Jammu. Trial was conducted under 5 year's old plantation of poplar, to find out the growth and yield of tomato, brinjal, okra in kharif. All the vegetables were grown in open as well as under shade of poplar trees with five treatments T₁: RDF of NPK, T₂: 50%N+50%N through FYM, T₃: 100% N through FYM, T₄: 50%N+50%N through VC, T₅: 100% N through VC. Significant affect of shade and fertilizer treatments was recorded on the growth and yield of all the vegetables under poplar. The yields of all the crops were reduced under shade of poplar in comparison to open. Highest growth and yield was recorded in treatment T₁ (Recommended dose of NPK). The results showed that brinjal gave highest yield followed by tomato and okra. In all the crops highest yield was recorded in treatment T₁ (recommended dose of fertilizers).

PRESENT STATUS OF ORGANIC CERTIFICATION IN INDIA

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India is home to 30 percent of the total organic producers in the world. India ranks 9th in World organic agricultural land and 1st in total number of producers (as per FIBL & FOAM Year book 2018). Organic farm produce have huge potential to increase their domestic consumption and exports. The demand for organic agricultural products is growing rapidly as consumers have started to become more aware and concentrate on the quality of the food they consume. Organic certification addresses a growing worldwide demand for organic food.

India Organic certification is a mark for organically farmed food products manufactured in India. Organic certified displays the 'India Organic' logo for customer to easily identify certified products. Large scale farmers and groups of small farmers who have taken up organic farming are now getting organic certification for their produce, which enables customer to be assured of buying actual organic products and enables the farmer to get a premium on his returns.

The total area under organic certification process is 3.67 million hect in 2019. The total volume of export during 2019 was 6.389 lakh MT. The organic food export realization was around INR 4,686 crore (689 million USD). The certification mark certifies India produced around 2.75 million MT (2019-20) of certified organic products. The farmers easily export the organic farm produce easily throughout the world. The government providing subsidies to farmers in many schemes and also eligible for all government schemes after obtaining Organic Certification. Organic certification is intended to assure quality and prevent fraud, and to promote commerce of Organic farm produce.

Keywords : Organic farming, Indian Organic Certification, Demand, Trade.

TRADE PERFORMANCE OF SPICES IN INDIA

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India - "The Land of Spices" produces a wide range of spices and holds a prominent position in world spice production. Spices is one of the economically and commercially significant agriculture crops in the world. India is the major producer, consumer and exporter of spices in the world. Spices have a long history of being one of the most highly traded commodities across the globe. Spice export trade constitutes an important segment of the Indian agricultural exports. Spices has been a prime source of livelihood for millions of people and above 3 million farmers are engaged. Under the act of Indian Parliament, a total of 52 spices are brought under the purview of Spices Board. However 109 spices are notified in the International Organization for Standardization [ISO] list. India produces about 60 Lakh MT of spices, of which, about 6.9 Lakh MT (11%) is exported to more than 150 countries. Spices stands fourth in terms of export value among agricultural exports from India. Spices exports has increased from 4,90,225 tonnes in 2007 to more than double at tonnes in 2019. The sustainability of Indian spices market is mainly depends on Trade performance. The present paper aims to study the Export, Import, Balance of Trade, International trade of Spices.

Keywords: Spices, Trade performance, Balance of trade, International trade.

BIOCHAR-BOON TO SOIL HEALTH AND CROP PRODUCTION

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Soil health is defined as the capacity of a soil to function within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health. Primary functions of soil include sustaining biological productivity, regulating water flow, storing and cycling of nutrients, filtering, buffering, and transforming organic and inorganic materials. The decrease in biomass production, decrease in organic matter supply and increased decomposition rate are the primary factors to reduction in soil organic matter. Biochar is a stable carbon compound created when biomass is heated to temperatures between 300 and 1000 °C, under low oxygen concentrations. Fire accelerates carbon cycle, but biochar decelerates it. It is commonly defined as charred organic matter, produced with the intent to deliberately sequester carbon and improve soil properties. Biochar a byproduct of biomass pyrolysis has been suggested as a meant combat climate change and at the same time to achieve agricultural and environmental benefits. Biochar is to abate the enhanced greenhouse effect by sequestering C in soils, while concurrently improving soil quality. Application of biochar is very imperative to increase soil fertility, enhance nutrient uptake, ameliorate Cr polluted soils and reduce the amount of carbon produced due to biomass burning. It has the potential to increase conventional agricultural productivity and mitigate green house gas emissions from agricultural soils.

Key Words: biological productivity, carbon compound, soil quality, green house gas

OPTIMIZATION OF STORAGE STRUCTURE: ZERO ENERGY COOL CHAMBER (ZECC), POT UNDER POT STORAGE AND NORMAL STORAGE

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According to the Agricultural senses 2011, the postharvest loss of horticulture produce in average is 30%. There are different modern techniques developed to store the horticulture produce like refrigerated storage systems. But the problem is that they are costlier and the marginal farmers cannot afford them. So the low cost effective storage techniques is the necessity of marginal farmers who constitutes 70% of Indian Farming Community.

Two standard ZECC, one revised ZECC and pot under pot storage was constructed and the comparative study of different parameters among themselves and with normal storage was done. The horticulture produce (tomatoes and leafy vegetables) was stored in these storage structures. Temperature difference of 5.05 °C in revised ZECC, 6.09 °C in standard ZECC, 6.98 °C in pot storage 1 and 6.83 °C in pot storage 2 with respect to normal temperature was obtained. Also, the RH in revised ZECC, standard ZECC and pot storage 1 and pot storage 2 was obtained as 84.67%, 86.26%, 86.59% and 89.17% respectively as compared to 73.73% in normal storage. The PLW for tomatoes and leafy vegetables was reduced to 13.5 %, 11%, 9.5% and 11.76%, 10.5%, 9.5% in revised ZECC, standard ZECC and pot storage respectively as compared to 21% and 23.1% in normal storage. The better combination of temperature and RH in these storage structure resulted in increases of shelf life of horticulture produce. The shelf life of tomatoes and leafy vegetables were increased up to 10 days and 3 days in these storage structures as compared to just 4 days and 1 day in normal storage.

Keywords: Shelf life, ZECC, RH, temperature difference, PLW

ANTIFEEDANT ACTIVITY OF PLANT EXTRACTS AGAINST *Spodoptera frugiperda* (J. E. SMITH) (LEPIDOPTERA: NOCTUIDAE)

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Antifeedant activity of plant extracts against *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) was carried out during 2019 at University Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S)-444104. Botanical extracts are eco-friendly, economical, usually target-specific and biodegradable, act not only as insecticides but also function as antifeedants, oviposition deterrents and ovicides. The experiment was laid out in Factorial Completely Randomized Design with twenty treatment combinations and present investigation reports on the antifeedant property of seed components of *Azadirachta indica* and leaf component of *Tagetes erecta*, *Lantana camara* and *Ocimum sanctum*. Solvent residues of these components obtained from different solvent extracts used such as hexane, diethyl ether, dichloro methane, ethyl acetate and methanol dissolved in acetone were separately tested at 1 per cent concentration continuously for 24, 48 and 72 hours on the third instar larvae of fall armyworm *Spodoptera frugiperda*. The results indicated that highest per cent antifeedant activity against 3rd instar larvae were recorded in 1 per cent Neem seed kernel extract by using ethyl acetate solvent at 48 hours followed by 24 and 72 hours observation i.e. (75.17 to 60.95 per cent) found at par with 1 per cent Neem seed kernel by using methanol solvent and 1 per cent Lantana leaf extract by using ethyl acetate solvent and least is recorded in 1 per cent Marigold leaf extract by using dichloro methane solvent i.e. (17.99 to 34.59 per cent). The results indicate the presence of antifeedant effect which was maximum in *Azadirachta indica*. This was inferred from the lower food consumption ingested by the larvae on maize leaves containing solvent residues of these botanicals.

Key words: *Spodoptera frugiperda*, Antifeedant Activity, Plant extracts, Solvents.

SITE SPECIFIC NUTRIENT MANAGEMENT IN FRUIT CROPS

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Site specific nutrient management is a crop management strategy of precision agriculture which is useful technology for growing and fertilizing fruit crops more precisely or efficiently and consequently can help retain water and nutrients in the root zone. Implementation of SSNM minimize the nutrient loss, conservation practices to control runoff, and practices to trap materials leaving the field should be utilized as a combination of efforts. Better doses of SSNM over recommended doses of (RDF) including those of farmers usual fertilizer practices signals a wake-up call to address the fertilizer requirements of the principles of SSNM. Variable rate of fertilizer application (VRF) one of the most precision tool for keeping the nutrients in the rootzone. Successful implementation of SSNM relies on accurate quantification of the spatial variation of important soil and crop factors and their interpretation in to variable rates of agrochemical that are targeted only to crop canopies and root zones. Remote sensing surveys and yield mapping both of

which used to create prescription maps for SSNM. Modern precision agriculture technology like GIS, GPS, Remote sensing, mobile and embedded computing and soil or crop mapping offers the tools which can be used for more efficient nutrient management of horticultural crops.

Key words: SSNM, Spatial variation, Variable rate fertilizer, Yield mapping, Remote sensing, GPS, GIS

EFFECT OF DIFFERENT SOURCES OF BORON ON FLOWERING AND YIELD OF MANGO CV. AMRAPALI

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The present investigation was carried out at Instructional Research Farm, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus during November 2017-August 2018. The experiment was laid out in Randomized Block Design with three replications and seven treatments of different boron sources viz., T₁: Agricol 2.5 g, T₂: Agricol 5g, T₃: Chemibor-P 2.5 g, T₄ Chemibor -P 5g, T₅: Disodium Octaborate Tetrahydrate 2.5 g, T₆: Disodium Octaborate Tetrahydrate 5g, T₇: control (distilled water). Boron from mineral sources were applied on the soil at two stages *i.e.*, before flowering and at pea stage. Data were collected from N-E and S-W aspects of the tree canopy. Results revealed that the earliest panicle emergence, minimum number of days for 50% flowering (22.51 and 22.07), full bloom (30.29 and 30.66), days to fruit set (57.27 and 56.83) and days to harvesting from panicle initiation (168.26 and 168.00) were obtained with Agricol (2.5 g). Maximum fruit weight (211.49 g and 207.80 g), fruit yield (kg/tree) (46.2 and 45.9) significantly increased with Agricol (2.5 g) application. The number of hermaphrodite flower/panicle (208.55 and 207.71), sex ratio/panicle (0.66 and 0.61) and least fruit drop (51.23 and 50.50) was found maximum with application of DOT (2.5g) The lower concentrations of boron from various sources performed better in the present study.

Key words: Mango, mineral boron, flowering, fruit yield and quality

MOLECULAR REGULATION ON BLOOMING PATHWAY GENES OF FRUIT CROPS

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Flowering is a cascade reaction consisting of numerous steps. Flower development is a transition phase in the life cycle of a plant. The plant must attain specific state of ripeness to respond before it flowers. It is of immense importance for perpetuation and origin of variability in the next generations. Flowering is a critical phenological stage in relation to commercial viability of orchard. It is important to understand floral induction in fruit trees to ensure regular flower bud formation which is a pre requisite for stable production every year. The understanding of the molecular regulation of the flowering process is crucial for controlling fruit production. The expression of mango Flowering Locus T (MiFT) and Terminal Flower 1 (MiTFL1) genes in cultivars 'Alphonso' and 'Ratna' with treatment of PBZ to ensure flowering in treated plants and gibberellic acid (GA) to

ensure no flowering in treated plants. All the plants treated with PBZ flowered, while none of the plants treated with GA flowered. Expression of both MiFT1 and MiFT3 was much higher in PBZ-treated plants compared with GA-treated plants in both cultivars, consistent with a role in floral induction. In fig the data suggest that *FcFT1*'s unique expression features are responsible for the distinctive flowering and fruit bearing characteristics of fig. Information about flowering mechanisms in Arabidopsis has greatly facilitated our understanding of these mechanisms in fruit crops and thus critical in studying mechanisms in plants that are highly valued in horticulture.

Keywords: fruit crops, flowering genes, mango, fig.

ROLE OF MOBILE APPLICATIONS IN AGRICULTURE: A REVIEW

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Farming community contributes about 17 % of India's GDP. Agriculture is plagued by enormous problems, However the most essential bottlenecks are lack of instant information. To conquer these issues, agriculture should be made more captivating and done smartly. Smart agriculture aims to increase agriculture productivity to meet out the future demands of growing population. Today the mobile phones are used worldwide, including countryside people and farmers. With the increase in ICT revolution a variety of mobile applications have been arisen and these could be utilized by farmers and make them acquire proper guidance about crop management practices and, weather forecast, marketing networks. Mobile application plays a vital role and acts as a easy source of information to Indian agriculturists, farmers and growers.

Key words: Mobile application, Smart Agriculture.

ROLE OF NANOTECHNOLOGY IN FRUIT CROPS: AN OVERVIEW

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In the era of increasing population and climate change, global agricultural systems are facing numerous, unprecedented challenges. In order to achieve food security, advanced nano engineering is a handy tool for boosting crop production and assuring sustainability. The science of nanotechnology has the ability to work at atomic, molecular and even sub molecular levels at a dimension of roughly 1-100 nanometers in order to create and use material structures, devices and systems with new properties and functions. Major applicable areas of nanotechnology in fruit crops are nutrition, plant protection and post harvest management. Nanotechnology helps to improve agricultural production by increasing the efficiency of inputs and minimizing relevant losses. Nanomaterials offer a wider specific surface area to fertilizers and pesticides. In addition, nanomaterials as unique carriers of agrochemicals facilitate the site-targeted controlled delivery of nutrients with increased crop protection. Post harvest losses of fruits can be reduced by using nano membranes due to their greater strength, higher resistance to permeability, higher heat stability and transport potential can also be improved.

Key words: Nanotechnology, fruits, horticulture

INSECTIGATION – A POTENTIAL NOVEL APPROACH FOR INSECT PEST MANAGEMENT

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Agriculture in one or other way is constantly exposed to threat from many biotic stresses *viz.*, insects, pathogens, nematodes *etc.* Among them, insects alone contribute a significant amount of damage to crops which leads to lower production and productivity. To combat the stress caused by the insect pests many conventional strategies like, use of botanicals, practicing biological control, application of biopesticides, spraying of chemical insecticides, which are part of integrated pest management have been widely practiced. However, use of chemicals to control the insect pests shows quick and promising results. On the pretext of the chemical control, a novel approach to tackle the insect pests is ‘‘Insectigation’’. Insectigation refers to application of insecticides through irrigation water exclusively by drip irrigation. This approach is more advantageous over traditional spraying in terms of plant will absorb both water and insecticide at same period of time, reduction of spray fluid drift, reduction of residues and can eliminate the human exposure to insecticides. Despite, advantages phytotoxicity and drip clogging are challenging in insectigation. This method predominantly used to control the sucking pests, soil residing pests and different growth stages of insects *viz.*, egg, larvae, pupae and adult which requires soil for development. There are certain classes of insecticides which are compatible with drip irrigation includes, neonicotinoids, diamides and oxadiazines *etc.* In contrast, carbamates, pyrethroids and organophosphates are not compatible with drip irrigation. In India, Insecticide mixture Chlorantraniliprole 08.80% + Thiamethoxam 17.50% SC is the only one registered for soil application. In a nutshell, insectigation offers a wide range of benefits over traditional approaches to mitigate the insect pest population and to enhance the agriculture production.

Key words: Insectigation, neonicotinoids, diamides, oxadiazines, sucking pests, soil pests, Chlorantraniliprole 08.80% + Thiamethoxam 17.50% SC *etc*

GREEN TO GRAIN: STAY-GREEN, A KEY TRAIT FOR CLIMATE RESILIENCE

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Increasing demand for the climate resilient crops in the global agricultural scenario, stay-green phenotype gained the attention of plant breeders. Crop yield under stress strongly depends on photosynthates provided either through current photosynthesis or through the remobilization of stored carbohydrates from the stem. Stay-green (SG) is the most significant trait, which allows the plants to retain green leaf area for longer time after anthesis than standard genotypes, maintains photosynthetic activity and assimilation process and subsequently increase the crop yield. Cytokinin accumulation, ABA reduction and impairment in the chlorophyll degradation pathways will leads to stay-green. The C/N balance during source to sink transition can play a vital role in onset of leaf senescence, where high carbon and low nitrogen accelerates the leaf senescence. SG phenotype delayed the remobilization of N from leaves and maintains photosynthetic capacity for longer, sometimes leading to higher grain yield. The SG phenotype also play a vital role in adaptation of

crops to challenging environmental condition such as drought and heat stress without compromising yield. Many quantitative trait loci (QTLs) for SG has been identified in various crops. The SG QTLs are found co-localized in the genomic regions of several agronomically important traits. Therefore, selection of SG phenotype with other valuable traits is the efficient strategy for breeding climate resilient crops.

Key words: Stay-green, senescence, drought, heat, yield, breeding

IMPACT OF CROP BIO-FORTIFICATION ON FOOD SECURITY AND NUTRITIONAL SECURITY IN INDIA

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Food security of the country has been improved due to green revolution and enhancement of cereal production. Main concern of green revolution was laid on yield increase not on quality food production and it scale down soil productivity accompanied by less nutritive food grain production. Malnutrition is an alarming problem in the world. While providing enough calories, monotonous diets based on cereals and other starchy staple foods often fail to provide sufficient quantities of essential minerals and vitamins like iodine, iron, zinc and vitamin A and thus create a “hidden hunger” of micronutrient malnutrition (Demment and Allen, 2003). Major strategies to address and tackle the malnutrition are dietary-diversification, medical supplementation, food fortification and biofortification. While all approaches is effective under ideal situations, ‘biofortification’ remains the most sustainable and cost-effective mean for providing the desired levels of nutrients in the diet in natural form. Biofortification offer sustainable solutions to the escalating micronutrient-related malnutrition problems. Two-three foliar sprays of Zn and Fe (0.5% ZnSO₄ and FeSO₄) on later growth stages offer a practical and useful means for bio-fortification with Zn and Fe. Concentration of micronutrients increases 60-80% in cereal grains and 50-65% in pulses over control. Foliar application of micronutrients results significantly higher micronutrient recovery percent over soil application. Adequate information programmes are needed to create public awareness for the adoption of the varieties by farmers and public acceptance by consumers, especially if there are obvious changes in the qualities of the crop, such as colour as in golden rice and white maize. With proper planning, execution and implementation, biofortified food crops will help India to address the malnutrition problem with minimum investment in research and have a significant impact on the lives and health of millions of needy people of the country.

Key words: Food security, Green revolution, Malnutrition, Biofortification, Golden rice

CURRENT STATUS OF BREEDING FOR PHYLLODY RESISTANCE IN SESAMUM (*Sesamum indicum* L.)

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Sesame (*Sesamum indicum* L.) is an important oil seed crop belonging to the family Pedaliaceae, grown in tropical and sub tropical regions of India. Sesame seed contains high oil (46-50%), rich protein (20%) and various minor nutrients such as vitamins and minerals, large amount of characteristic lignans (methylenedioxyphenyl compounds) such as sesaminandsesamolin. The yield

potential levels of the sesame crop is very low compared to the other oil seed crops due to the major factors effects narrow genetic bases and are extremely susceptible to the biotic and abiotic stresses. Sesamum phyllody disease is one of the major biotic stress causing the destructive damage to the sesame crop. Phyllody disease is transmitted by insect vector leafhopper (*Orosiusolbisinctus*) from infected to healthy plants. Now it requires breeding for tolerant or resistant varieties for development of new cultivars and lines that can withstand the various pathogens and have the sufficient yield under the field conditions. Some important methods like inter-specific hybridization, ovule culture, molecular characterization of qPCR and some biochemical studies are helpful for screening and identification the sesame phyllody under field and green house conditions. A simple and efficient protocol for producing aninterspecific hybrid between *Sesamum alatum* and *Sesamum indicum* through ovule culture. Screening against phyllody disease under greenhouse in their study revealed that hybrids were moderately resistant. Rajput and Raghuvanshi (2017) used the ratoon infected row technique for transmission of phyllody disease through leaf hopper in healthy plants for field resistance screening. Their study revealed screening the parents, F₁S, F₂, B₁, B₂ generations of crosses JLW-620 x JLS-116 and OSC366 x AT-183 in Field for resistance against phyllody disease. Thangjam and Vastrad(2018) studied changes in different biochemical parameters viz., total phenols, reducing sugar and total protein they were compared in healthy and phyllody infected plant samples of sesame (cv DSS-9) sown on different dates. Their Results indicated that the phyllody infected samples contained more total phenols, reducing sugar and total protein compared to the uninfected samples. Major problem in sesame crop to find out the resistant or tolerant genes of sesame phyllody disease caused by phytoplasma these are pleomorphic in nature and lack of cell wall. Complete phytoplasma genome sequencing has not been done so far and would be major area of research in the coming years. To overcome this problem, plant breeders however often needs to find out the resistance sources of tolerant or resistant varieties followed by different traditional, biotechnological and molecular breeding methods to reduce the incidence of sesame phyllody disease.

Keywords: Sesame, phyllody resistance, phytoplasma genome, molecular breeding.

A STUDY ON CONSTRAINTS AND SUGGESTIONS AS EXPRESSED BY FARMERS ON ADOPTION OF CLIMATE RESILIENT TECHNOLOGIES

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In 2011, ICAR launched National Innovations on Climate Resilient Agriculture (NICRA) project to develop climate resilient agriculture technologies through strategic research. It demonstrates and supported to adopt a wide-ranging technologies and improved practices for mitigating climate change to provoke farming as business. The present study was conducted in Anantapur district of Andhra Pradesh. A sample of 60 farmers as beneficiaries from NICRA villages and 60 farmers as nonbeneficiaries from non-NICRA villages are selected randomly. Ex-post facto design was used for the study. The constraints faced by the farmers for adoption of climate resilient technologies were lack of sufficient rainfall, lack of owned resources, lack of short duration and drought tolerant crop varieties, lack of knowledge about climate resilient practices and inadequate financial support. The major suggestions given by the respondents for adoption of climate resilient technologies are provision of technical information and guidance should be given on regular basis, training

programmes should be conducted on climate resilient practices, financial assistance should be given for soil and water conservation and technology demonstrations should also be given on need based problems.

Keywords: NICRA, climate resilient technologies.

CLIMATE RESILIENT AGRICULTURE INITIATIVE FOR SUSTAINABLE AGRICULTURE

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The climate change affects crop production in the adverse ways because of its impact, now it is emerging as a major priority among crop science researchers. Agriculture in this changing climatic scenario which is facing diverse challenges due to a wide array of demands. Climate-resilient agriculture is the need of the hour in many parts of the world. Understanding the adverse effects of climatic change on crop growth and development and developing strategies to counter these effects are of paramount importance for a sustainable climate-resilient agriculture. National Innovations on Climate Resilient Agriculture (NICRA) project launched by ICAR, aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The focus of the project is not only to demonstrate the climate resilient agriculture technologies but also to institutionalize mechanisms at the village level for continued adoption of such practice in sustainable manner. There should be focus on providing adequate funds to those states which are vulnerable to the various climatic changes, which seriously affect the agrarian families dependent on agriculture. The livestock related activities are also affected by the climatic changes, it is important to have a better livestock breeds selection and promising crop varieties which will have high tolerance to climatic stress across regions.

Keywords: NICRA, impact, climate resilient technologies

HOW DIGITAL STARTUPS IN AGRICULTURE CAN STRENGTHEN EXTENSION SYSTEM

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The Indian public extension system is reeling severe financial crisis and cannot carry out their operations in an effective manner. Extension systems were impactful in the past when there was an information and technological disequilibrium between farmer and service providers. Over time, as increasing numbers of farmers become aware of a specific technological thrust, the impact of such extension diminishes, until the opportunity and need for more information-intensive technologies arise. This situation warrants extension systems to focus on disequilibria shift from production technology to market linkages and information access issues. Sensing the above lacunae in the public extension system and making use of the technological revolutions in the era of internet, many giant companies have floated their startups to serve the farming fraternity and reap benefits at the same time. The startups are making use of internet as a medium to connect to the farmers. They

realized, a mere use of digital technologies will not help them in securing the confidence of their client system and are integrating their digital technologies with their personal staff system. Agricultural start-ups are the new entries in the field of agricultural extension. Outcomes of three agricultural start-ups i.e. eFresh, NaPanta and KhethiNext are studied. The study was carried out in the states of Andhra Pradesh and Telanagana. Thirty beneficiary farmers from each startup were selected randomly, thus making the total respondents to 90. An outcome is an effect that startups produce on the people. Outcomes of the agricultural digital startups are studied under 3 parts, i.e. 1. General Service outcome, 2. Faith outcome, 3. Orientation outcome. Five and half (5.55) per cent of the farmers felt that the services of the startups were less favorable and 41.11 per cent of the sampled farmers felt services were moderately satisfactory. 53.33 per cent of the farmers felt services were highly favorable to them. Majority of the farmers expressed moderate faith in the staff working with startups. After analyzing the startups in agriculture it is felt that collaboration between startups and public extension agencies, building the capacities of the personnel, technological up gradation of the extension system, developing comprehensive digital platforms and improving digital literacy of farmers are of prime concern for improving the public extension system

Key words: Public Extension system, Startups, Digital, Agriculture.

SYSTEM OF RAGI INTENSIFICATION: AN EFFECTIVE REMEDY FOR MALNUTRITION

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Agricultural technology is the knowledge used in improving productivity with a combination of inputs and changes in it from time to time for maximizing productivity. Ragi, a traditional subsistence staple crop grown in dryland and most nutritious of all the major cereal crops, rich in calcium, iron, protein and fiber. The cultivation of ragi, is declining due to changing farming systems and low productivity. Improved practices in cultivation of ragi can enhance the production. Agro-ecological approaches like System of Intensification in crops aims to produce crops more efficiently and sustainably. SRI is based on harvesting sunlight through higher bio-mass production and by facilitating more root-volume growth and microbial population in the root zone through aeration and more organic inputs. With the increasing adoption and success of SRI in rice cultivation, the principles of SRI were experimented with other crops. In ragi also almost similar agronomic practices of wider spacing, early transplanting of seedlings and inter-cultivation to create more aerated soil is followed. The land is ploughed thoroughly 2 to 3 times and compost applied during land preparation. 15-18 days old seedlings are transplanted, with mass of soil attached to the root at a spacing of 30 x 30 cm and there is moisture in the field. Organic manure is applied in the pits at the time of planting. Weeding is done with a roller weeder and jeevamrutha solution is applied after each weeding. Pests controlled with neem oil solution. Harvesting is easier as plant growth is more uniform and the mature fingers do not get entangled. A productivity range of 3 to 6 tons per hectare is possible depending on soil types and the availability of crop saving irrigation. Thus this neglected crop can be an easy local solution to counter the agricultural problems posed by climate change and an effective remedy for malnutrition in Indian population.

Key words: Ragi, System of Intensification, productivity.

EVALUATION OF SHOOT AND FRUIT INFESTATION OF ABELMOSCHUS ESCULENTUS (L.) MOENCHBY SHOOT AND FRUIT BORER

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The present investigation entitled on “Evaluation Of Shoot And Fruit Infestation Of *Abelmoschus esculentus*(L.) Moench By Shoot And Fruit Borer” was carried out at Department of Vegetable Science, Dr. PDKV, Akola during *kharif* season of 2019. The experiment was Randomized block design with nine treatments which were replicate thrice. An aim of experiment was to evaluate effect of some mechanical, botanical, physical and chemical treatments on shoot and fruit infestation due to shoot and fruit borer on okra. Mechanical treatment was consist of removal of infested shoots, botanical treatment was NSE 5% spray, physical treatment was consist of light trap where all these treatments in combination with each other were tested in comparison with insecticidal treatment involving spray of imidacloprid 17.8% SL and fenvalerate 20% EC. Among all the treatments tested clearly indicated that lowest mean shoot (4.78%) and fruit damage on number basis (14.96%) as well as weight basis (14.56%) was observed from T₉ (Recommended insecticide spray) which was at par with T₇ (Removal of infested shoots + Light trap + NSE 5%) with second most lowest shoot damage (5.34%), fruit damage on number basis (19.11%) and weight basis (18.77%). So, T₇ (Removal of infested shoots + Light trap + NSE 5%) could be better alternative to insecticidal treatment in order to produce pesticide residue free okra fruits. Significantly all other treatments were superior over control which showed highest shoot damage (15.77%), fruit damage on number basis (35.52%) and weight basis (34.67%). Only T₁ (Removal of infested shoots only) was least effective in reducing shoot and fruit damage on okra.

Keywords : *Abelmoschus esculentus*(L.) Moench, *Eariasvittella*, Shoot infestation, Fruit damage, Number basis, Weight basis.

MANAGING HEAT STRESS IN FIELD CROPS THROUGH AGRONOMIC INTERVENTIONS

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Population of the world is increasing at an alarming rate and is expected to reach about nine to ten billion by the end of year 2050. The growing population will result in considerable additional demand for food and it will also contribute towards changing climate, which is an alarming issue to the world's food safety. As a result of climate change the global mean surface air temperature increased by 0.5°C in the twentieth century and is expected to increase a further 1.5–4.5°C by the late twenty-first century. A single degree rise in temperature, beyond the threshold level, is considered heat stress in plants. The rise in temperature resulting in heat stress will limit crop growth, metabolism which may lead to significant loss of yield worldwide. To combat heat stress, plants acquire various defense mechanisms such as maintaining membrane stability and scavenging reactive oxygen species by generating antioxidants and stress proteins. Apart from defense mechanisms adopted by crop, there are some crop husbandry practices which can be successfully employed to mitigate the effect of stress. Adjustment in sowing time is one of the most important

agronomic interventions to counteract the adverse effect of temperature stress. Adoption of various agronomic management practices such as tillage options like zero tillage residue retention, water management, and foliar application, or pre-sowing seed treatment can help in mitigating or alleviating the adverse effect of high stress and thus helps in maintaining the productivity level of field crops.

Key words: Agronomic interventions, field crops, heat stress, high temperature, yield

NUTRIENT REMOVAL PATTERN OF WEEDS DUE TO TRADITIONAL WEED MANAGEMENT PRACTICES IN MAIZE

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Weeds compete with crops for nutrients and the nutrient removal by weeds is a serious problem in widely spaced crop like maize. Traditional weed management methods offer a wide scope for reducing the nutrient removal by weeds by effective management methods. Field experiment was conducted to study the influence of traditional weed management methods on nutrient removal by weeds in maize at Tamil Nadu Agricultural University, Coimbatore during *Kharif* 2017. Common salt (30%), vinegar (20%) and traditional formulation containing cow urine, lemon fruit, dried fruits of Indian walnut (*Terminalia chebula*) in two concentration @7.5 and 10 L ha⁻¹ were used as post emergence spray with or without hand weeding on 45 DAS. Hand weeding twice at 20 and 45 DAS and weedy check were also maintained for comparison. At 30 DAS, lower nitrogen, phosphorus and potassium removal by weeds (0.68, 0.08 and 0.45 kg ha⁻¹) was observed in hand weeding twice on 20 and 45 DAS. Hand weeding twice on 20 and 45 DAS registered significantly lower nitrogen (0.2 and 1.40 kg ha⁻¹), phosphorus (0.02 and 0.19 kg ha⁻¹) and potassium (0.21 and 1.48 kg ha⁻¹) removal which was merely comparable with post emergence application of vinegar 20% + hand weeding on 45 DAS (0.71 and 1.83 kg ha⁻¹; 0.07 and 0.25 kg ha⁻¹; 0.73 and 1.94 kg ha⁻¹) at 60 DAS and harvest. All the traditional weed management methods resulted in lower nutrient removal by weeds compared to weedy check.

Key words: Maize, nutrient removal, traditional weed management methods, vinegar, weeds

AGRICULTURE AS A SOLUTION FOR CLIMATE CHANGE

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Globally, climate change (CC) is the most serious environmental threat that adversely affects agricultural productivity. According to inter-governmental panel on climate change [2] (IPCC) report, climate change refers to any change in climate over time, due to natural variability or as a result of human activity. This climate change mainly caused by greenhouse gases (GHGs) accumulation in the atmosphere, which results in increased greenhouse effect. Climate change and agriculture are interrelated processes, both of which take place on a global scale and their relationship is of particular importance as the imbalance between world population and world food production increases. The

agricultural sector hold significant climate change mitigation potential through reductions of GHG emissions and enhancement of agricultural sequestration. In addition, it also has significant role to adapt climate change. Adaptation alone is not enough to offset the effects of climate change, and thus still need to be supplemented by concerted mitigation effort. Mostly, when we implement adaptation measure, we enhance mitigation capacity of particular area such as practicing different land use managements (soil and water conservation measure, manure and fertilizer management) in the agricultural field will help us to sequester substantial amount of carbon in the field and reduce emission of methane and nitrous oxide which are the main GHG emission means. Therefore, the management activities are interrelated and help us to adapt and mitigate climate change. Agricultural activities are relatively affordable form of mitigation option, for which many technical options are already readily available.

SEWAGE SLUDGE IS A BIOSOLID ORGANIC PRODUCT, A USEFUL FOR CARBON SEQUESTRATION AND SUSTAINABLE AGRICULTURE

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The production of waste waste sludge (Biosolids) is rapidly growing as a result of worldwide daily population growth, urban planning and development. Slots should be appropriately handled and controlled in an environmentally friendly way where their use or removal has a detrimental effect. This analysis discusses the numerous uses of drainage lots for carbon sequestration and sustainable farming. There are large concentrations of biosolids in the treatment plants. The focus of this study is on numerous applications of biosolids and/or water sludge as biosolids and sewage sludges are widely used in many countries for a variety of applications such as biological gas processing, ground filling, organic fertiliser, soil alteration and crops cultivation. Biosolids or waste sludge are also worldwide regarded as a fuel. Apart from that, there are still significant restrictions on the application of biosolids or waste sludges in various areas with diverse heavy metals and microorganisms. This analysis therefore highlights the numerous uses and potential drawbacks for biosolids or sewage loam as a resource. Carbon sequestering (C) has created broad concern for the mitigation of climate change effects in soils as a result of increasing organic carbon (SOC) supply. The application of soil biosolids can be a continuous rise for the SOC reservoir. While a wide literature on the role of biosolids in agricultural systems is available as a soil conditioner or nutrient supply, the sequestration mechanisms of biosolids-borne C or the primary influencers of this capability remain limited in understanding. Efforts were made to make biosolids or waste sludge for their product potential pretreatment more feasible. Therefore, in the present analysis the various characteristics of biofog or sewage sludge as a resource for sustainable development were addressed, along with potential restrictions, to shape biosolids or wastewater sludge. . The challenges arising from global environmental change and the strict need to develop C storage need more research into the potential of integration of soil biofuels as a sustainable C storage solution. In this study, the C sequestration of land and opencast mines with biosolids and their biological regulations is discussed.

Keywords: Agricultural uses, Organic fertilizer, Biosolids, Carbon Sequestration, Soil amendment, Sustainability.

CONVERSION FROM CONVENTIONAL TO ORGANIC FRAMING

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Organic farming has its genesis of origin in the ancient period. It is a holistic approach system approach of production. Organic farming totally forbids the use of synthetic inputs such as chemical fertilizers, insecticides, pesticides, plant growth regulators etc. Conventional agriculture has played an important role in improving food productivity to meet human demands but is often associated with problems such as nitrate leaching soil erosion and environmental contamination. The demand for organic food is steadily increasing both in the developed and developing countries which opened the doors for farmers to move from conventional to towards organic. We addressed how a conventionally managed farm becomes an organic farm. The conversion from conventional to organic farming involved precautions in each step like filling of form, selection of site, input use, conversion period require etc. in compliance of even single step may cancel organic certification. Organic farming is the answer to the problems being faced by agriculture in India today. This form of agriculture conserves our soil and water resources, protect our climate, improve agro-diversity, ensure biodiversity, and meet the demand for food.

Key words: Conventional, certification, organic, agro-diversity

AQUAPONICS- A WAY TO RESIDUE FREE PRODUCTION

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Aquaponics is getting popular among urban growers. Aquaponics is combination of aquaculture and hydroponics. It is sustainable way of raising both fishes and vegetables. With aquaponics we can grow more food with less water, land and labor than traditional agriculture. In aquaponics the nutrient-rich water from raising fish provides a natural fertilizer for the plants and the plants helps to purify the water for the fish. Thus, there is no reliance on mined and manufactured fertilizers. As fish are sensitive to chemicals there is no scope of using pesticides in aquaponics. Soil is not used as growing media, thus eliminating soil, eliminates soil borne diseases. Produce is free from pesticides and herbicides, fish are free of growth hormones and antibiotics it makes aquaponics efficient, sustainable and highly productive method.

Aquaponics can be used to sustainably raise fresh fish and vegetables for a family, to feed a village or to generate profit in a commercial farming venture, year round, in any climate. Commercially, aquaponics is a rapidly growing industry as entrepreneurs realize that aquaponics and controlled environment agriculture can provide high quality, locally-grown fresh food on a year round basis. Large commercial aquaponics farms are providing fresh food to grocery store chains, hospitals and institutions.

Keywords: aquaponics, sustainable, pesticides.

GREEN TECHNOLOGY FOR SUSTAINABLE AGRICULTURE

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Indiscriminate application of different fertilizers and pesticides resulted in the negative impact on the environment, crops and soil in the long run. To mitigate this problem the use of green technology may be a great area to be worked to solve out this problem. Green technology covers a constantly evolving group of method and materials, from methods and practices for generating energy to non-toxic cleaning products. In agriculture one such technique is the hydroponics farming which uses 60 to 80 % less water than conventional outdoor farms, next approach is the sub surface drip irrigation that proved an innovative solution for field crop irrigation. The use of organic residues like crop residue, biochar, green manures, vermicomposting and other residues which were recycled. The benefit they provide are excellent such as soil fertility maintenance, microbiome improvement, physical improvement in soil, and maintenance of eco friendly environment for every crop and ecosystem species. The use of such green technology will be helpful in future prospects as they are alternative of conventional sources in the long run. But to make these green technologies more sustainable more improvement to be done in the current methods so to make it more reliable for the future prospective.

Keywords: nanobioformulation , nanoparticles, nanoherbicide

BIOTECHNOLOGY APPROACHES FOR WEED MANAGEMENT IN CHANGING CLIMATIC CONDITION DEEPAK KUMAR YADAV^{1*}

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Weed are those which are there are out of places at a time where they not need. They need light, air, spaces and nutrients for their growth and development; resulted as the competition among the weed and crop for these limited resources. In traditional scenario of the crop cultivation having the ability to withstand in competition with weed but during green revolution introduction of dwarf variety with increase of input application (irrigation, fertilizer) for higher yield obtaining to meet the food demand of growing population. There are also enhance the dependence on the herbicidal approach of weed management in the scarcity of labour, wages of labour etc. with no new herbicidal group discovery within decades makes the weed as herbicide resistance weed, weed shift etc. and finally increasing the cost of management, harming the environment, and increasing the chemicals in food chain. Biotechnological approaches can be achieved by the study of biological system response, living organisms or parts of this with computerization application, which makes differences and facilitate to control of weed population. There are various approaches for management of weed by using biotechnology like; development of such crop which are herbicide resistant (facilitate to application of non-selective herbicide to knock down the weed); improvement of biocontrol agents through biotechnology; transgenic allelopathy development in crops and characterization of weeds using molecular systematic for effectively control. The effectively management of weeds by biotechnological approaches makes the self sufficiency in foods/ food security; saving of money by reducing herbicidal misuse, application etc. and sustainability of resources by reducing herbicidal loads.

Keywords: Biotechnology, Weed Management, Changing Climatic.

ASSESSING THE EFFECT OF CLIMATIC VARIABILITY ON FLOWERING, FRUITING AND QUALITY PARAMETERS OF MANGO CULTIVARS

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A field experiment was conducted at Agriculture Experimental Station, Navsari Agricultural University, Paria (Gujarat) during October 2018 to September 2019. The variation in different characters among mango varieties viz., Kesar, Mallika, Amrapali, Dashehari and Langra might be due to variation in genetic makeup and abiotic factors. Average maximum fruit set and yield were obtained in temperature between maximum 31.00°C to 38.05°C and minimum in 12.94°C to 28.06°C, respectively. The difference between maximum and minimum days to reach 100 per cent flowering in different mango varieties was 6.6 days, while the duration of flowering ranges between 31.80 to 38.40 days, as minimum duration of flowering was recorded with Amrapali (31.80 days). On the average basis minimum days taken for 50 % of flowering was recorded with cv. Amrapali (10.20 days). Maximum and minimum sex ratio of 3.24 and 0.50 was recorded in Amrapali and Langra varieties, respectively. The average maximum percentage of fruit set (per panicle) at marble stage i.e. 2.59 % and fruit retention at maturity from fruit set (50.90 %) was noted with cv. Amrapali. However, on the average basis highest no. of fruits per tree (132.20) and yield (46.16 kg/tree) was obtained in cv. Kesar. The average fruit weight (627.44 g) was obtained within cv. Mallika. The highest TSS (19.87⁰B) and ascorbic acid (30.70 mg/100g) was obtained with cv. Amrapali and Langra, respectively. The minimum acidity (0.21 %) was observed with Kesar cultivar.

GENETIC STUDIES OF NUTRITIONAL TRAITS IN COMMON BEAN (*PHASEOLUS VULGARIS* L.) FROM VARIOUS TEMPERATE REGIONS OF JAMMU & KASHMIR

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Common bean (*Phaseolus vulgaris* L.) is the most important grain legume in human diets due to its high nutritional and commercial value. In sub-Saharan Africa, more than 200 million people depend on this crop as a primary staple food. Beans are also called “poor man’s meat” as it contains high protein, starch, dietary fiber and is an excellent source of micronutrients like iron, zinc, potassium, selenium, molybdenum, thiamine, vitamin B6 and folate. In Jammu & Kashmir it is grown in all regions which fall under temperate zone. Seed quality traits are important components of common bean crop improvement programmes, four nutritional traits were studied for association mapping in the present study. A set of 91 common bean lines were evaluated for phenotyping of seed quality traits viz. soluble protein, starch, sugar and phenol content. Then SSR marker genotyping was done with a set of 91 markers to study marker trait associations (MTAs) through association mapping for seed quality traits. We identified six MTAs for soluble protein having a phenotypic variation (%) range from 13.1 to 31.7, three MTAs for starch content contributing phenotypic variation range of 13.9% to 28.2%, 9 MTAs for sugar content contributing to phenotypic variation range of 11.3% to 30.3% and 3 MTAs for phenol content having phenotypic variation range of 17.3% to 23.9%. These MTAs will be useful for future molecular breeding programmes to enhance nutritional content in local landraces of J&K through marker assisted selection.

Keywords : Common bean, nutritional traits, MTA (marker trait association), SSR markers

SUSTAINABLE VEGETABLE PRODUCTION SYSTEMS IN CONTEXT OF BIHAR

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Vegetables are one of the good sources of vitamins and minerals and play an important role in ensuring food and nutritional security. Vegetable production provides jobs and supports agribusiness, thereby generating economic opportunities. Many vegetable cultivation systems are not sustainable. For example, some systems are rapidly pollute the environment due to intense applications of synthetic chemical fertilizers and pesticides, often leading to food contamination and ground water pollution and enhance the soil erosion. By the concept of organic farming, a holistic way of farming is one of the alternate forms that are aimed at sustainable vegetable production. It depend on crop rotations, green manures, organic manures, bio-fertilizers and biological pest management for crop production excluding or strictly limiting the use of synthetic fertilizers and chemical pesticides. Organic farming is the answer to the problems being faced by agriculture in India today. Under organic farming nutrient management is of utmost importance as the soil fertility has to be not only maintained but also to be improved. A healthy biologically active soil is the source of crop nutrition. A live, healthy soil with proper management and effective crop rotation can sustain optimum productivity over the years, without any loss in fertility. The application of appropriate quantity of organic manures can not only sustain the yield of vegetable crops but can also enhance it. The basic idea of nutrient supplementation in organic farming is to replace the requirement of nutrients through the use of permitted inputs. This form of agriculture conserves our soil and water resources, protects our climate, improves agro-diversity, fulfil the demand for quality food and protect the livelihoods. In brief, it ensures that the environment blooms, the farmers makes a net profit and society has ample nutritious food.

Keyword: Sustainable, organic farming and livelihoods

TOXIC EFFECTS OF LANASYN OLIVE AND DRIMAREN RED TEXTILE DYES ON ELEMENTAL COMPOSITION, PHYSIOLOGICAL AND BIOCHEMICAL LEVEL OF A FRESHWATER CHLOROPHYCEAN ALGA *Chlorella vulgaris* SAMCHETSHABAM GITA^{1,2}, SATYA PRAKASH SHUKLA^{1*}

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The present experiment evaluated the toxicity of two textile dye Drimaren red and Lanasyn olive towards *Chlorella vulgaris*. The parameter such as growth, protein, and pigments (total chlorophyll and carotenoid) were monitored. The study noticed the inhibition of growth, pigments (total chlorophyll and carotenoid) and protein content of the algae with increased dye concentration. More than 50% reduction in pigments level was observed. Further, elemental content (C,H,N,S) of the alga were studied after exposure for 96 h to observe the endpoint of the experiment. According to the analysis, content of all the four elements (C,H,N,S) were found to decrease which indicate the change in the element ratio of the tested alga. From the result, it was observed that as the concentration of dye increases toxicity also increases. So, more attention should be given to such dye waste water discharge in aquatic body and their effect in aquatic organisms.

Keywords: Lanasyn olive; Drimaren red; *Chlorella vulgaris*; Chlorophyll; Carotenoid

DAIRY FARM WASHED LIQUID MANURE APPLICATION IN FODDER PRODUCTION OM SINGH

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Highlights : Dairying is a major component of agriculture sector in India. Clean milk production is a big challenge in the country. Dairying operations need plenty of water every day which can be utilized for irrigation

Introduction : India is a agriculture based economy. India ranks first in milk production in the world. Agriculture provide employment for 65% population of the country. There is vast integrated network of agricultural education and scientific intensive farming system. Country needs doubling the income from agriculture system at farmers level. Hence livestock sector needs high attention to attain its objectives. Dairying is a integrated production system of agriculture.

Ojectives : 1. Rational use of water resources on the cattle and buffalo dairying farm, 2. Re-use of dairying wash off liquid manure for fodder crop production .

Abstract-body

Methodology Approach : The experiment was conducted at cattle and buffalo farm of Indian Veterinary Research Institute, Bareilly. U.P. in India in 2014-15. Four model of production system were studied to asses the dairying washed off water and liquid manure for fodder crop production on farm. Treatments were planned in Randomised Block Design in four replications. Treatments were T1 application hydrogel, T2 treatment of liquid manure with microorganism culture ,T3 treatment of dairy washed water with microorganism culture, T4 as a control. The soil of experimental area was sandy loam. Fodder guinea grass, pearl millet were cultivated for green fodder.

Analysis and Results : The data shows that cultivation of guinea grass over the area of 2.0 ha was influenced by the package of practices for forage grass and pearl millet crop for green production on the farm. The four samples were collected from each group of treatments. An average value for each treatment was calculated. The analysis of treatments is under process .However on the basis of partial analysis the results indicate that hydrogel application produced maximum green fodder from guinea grass and pearl millet crop at the rate of 725 q/ha and 675q/ha .Highest plant height and number of tillers were found with application of hydrogel. Crop treated with dairy washed liquid along with micro organism culture produced 650 q/ha of guinea grass and 620 q/ha green fodder. Dairy washed water treated with micro organism produced 570 q/ha of guinea grass and 530 q/ha . Treatment control produced lowest plant height of fodder grass an pearl millet .The fodder yield from control was 452 q/ha pearl millet and 415 q/ha guinea grass. The application of hydro gel retain more water for longer period which produced higher biomass. Micro organism treatment for dairy washed liquid manure and washed off water increased fodder production.

Conclusions and Recommendations : The above experiments reflects that application of hydro gel and treatment of liquid manure and washed off water improve biomass production of fodder crops. Hydrogel improves water retaintion for longer period. It provides moisture in root zone. During period of water scarcity hydrogel retain up to 400 times of its weight. Micro organism culture allowed carbon content of liquid manure and dairy washed off water in over the control. Micro organism survives on carbon content of liquid manure and dairy washed water. Crop cultivation of guinea grass was found better over the pear millet. Hydrogel and culture is recommended.

Keywords: Dairy, livestock, water, irrigation, crop production

PERFORMANCE OF DIFFERENT VARIETIES OF WHEAT UNDER *Ailanthus excelsa*(MAHARUKH) BASED AGROFORESTRY SYSTEM

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The present investigation was carried out during 2017-18 to find out the growth, yield, quality and economics of wheat under *A. excelsa* tree. The experiment was designed to growth wheat varieties (V₁: KRL 19, V₂: KRL 210, V₃: GW 451, V₄: GW 496) with four different distances from the tree base arranged from north towards south direction (D₁:168cm, D₂: 300cm, D₃: 432 cm, D₄: 564 cm) and D₀ as control in open condition. The experiment was planned and analysed with large plot techniques (CRD factorial concept) with two treatments and three repetitions for generating data. The wheat plant height, number of effective tillers m⁻², number of tillers plant⁻¹, number of effective tillers plant⁻¹, awns length, ear length, weight of ear, number of grain ear⁻¹ and test weight was recorded non-significant among all the varieties, however the distance from the tree base was found to be significant. In the distance from the tree base, plant height was maximum D₃ (agroforestry) at the harvest of wheat. However number of effective tillers m⁻², number of tillers plant⁻¹, number of effective tillers plant⁻¹, awns length, ear length, weight of ear, number of grain ear⁻¹ and test weight was maximum found in D₀ (control). Further the interaction effect between wheat varieties and distance from the tree base was found to non-significant in present study. The grain, straw and biological yield (kg ha⁻¹) was higher under open condition as compared to *A. excelsa* based agroforestry system where the grain, straw and biological yield among different wheat varieties significant. The maximum grain yield was in V₁ followed by V₂, but straw and biological yield was maximum V₂ among all varieties. It is noted that variety V₄ is sensitive to grow under less light resources for converting light energy into biological products. In addition, distance from the tree base was found to be significantly maximum in D₀ (control) followed by D₁ and D₂ under agroforestry system for grain, straw

Keywords:Wheat, agroforestry, varieties, distance.

IMPACT OF INTEGRATED NITROGEN MANAGEMENT ON YIELD AND ECONOMICS OF LOCAL GLUTINOUS MAIZE (*Zea mays* L.) IN MANIPUR

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An experiment was conducted at College of Agriculture, Imphal during the pre-kharif season of 2018 on acidic soil to find out integrated nutrient management effect on maize. The results revealed that the grain and stover yield of maize respond well to integrated nitrogen management rather than sole application of either chemical fertilizer (urea) or FYM. The result showed highest grain yield and stalk yield with the application RDN- 75% through urea + 25% through FYM. From the economic point of view, the highest monetary benefit in terms of net return and benefit cost ratio was associated with application of RDN-75% through urea + 25% through FYM. It can be concluded that the local glutinous maize (*Zea mays* L.) responded well to the integrated nitrogen management with application of RDN-75% through urea + 25% through FYM as expressed in yield.

Keywords: Local glutinous maize, INM, yield, economics;

REMOTE SENSING SYSTEM IN AGRICULTURE AND NATURAL RESOURCE MANAGEMENT

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Agriculture is of huge economic significance across the globe. It is comprised of complex interdependent processes. Today, real-time, reliable information on crop development is essential to support the transition towards maximising efficiency and sustainable production. Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance. Special cameras collect remotely sensed images, which help researcher sense things about the Earth. In contrast to conventional agricultural methods, the use of digital data can increase resource and cost efficiency drastically. Satellite imagery provides valuable insights into crop growth and development enabling farmers to use real-time and have competitive advantages. Radar monitoring enables weather-proof analysis during high cloud cover, while optical sensors differentiate crop type, health and maturity. Remote sensing in agriculture helps in identification, area estimation and monitoring of crops at regular interval. It also helps in detection of crop nutrient deficiency as a result of changes in their reflecting power. Advancements in space technology application opened possibilities of remote sensing in soil mapping. The physiological changes that occur in plants due to stress may change the spectral reflectance characteristic resulting in detection of stress amenable to remote sensing techniques aiding to take appropriate measures and to assess information on probable loss of production. Reliable crop yield estimates is one of the most important components in crop production forecasting as the information on crop production is very vital to the national food policy planning and economy of the country. Draught assessment is yet another area wherein remote sensing data have been used at operational level. It also work in accessing and analysing dynamic information on global environmental indicators related to climate change and gain actionable insights for disaster preparedness, response and recovery.

Keywords: Conventional agriculture, remote sensing, draught assessment.

PRECISION AGRICULTURE FOR SUSTAINABLE AGRICULTURAL SYSTEM

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Agricultural productivity nowadays may seem to have reached a stationary point due to the global availability of chemical inputs which are being used abundantly to improve crop yield. However, misuse of these products and lack of awareness of the field parameters can decrease the productivity and create environmental imbalance in the cultivation area. Now a days farming has become more scientific with thousands of farmers all over adopting the new equipment to make their farming more precise. All aspects of the environment– soil, weather, vegetation, water – vary from place to

place. All these factors help to determine the crop growth and its farming success. Farmers have always been aware of this, but they lacked the tools to measure, map and manage these variations precisely. Thus, precision farming (PA) can make a difference in food production facing the challenge of a rising world population and help farmers to achieve greater sustainability, environmental protection, higher productivity and economic benefits. It is about managing variations in the field accurately to grow more crops using lesser resources and reducing production costs and potential environmental risk. PA helps to achieve optimal conditions for plant growth and monitor the soil-plant physio-chemical parameters by placing an electric sensors and offer real time data ensuring an updated status of the field and plant parameters at all time. It saves time and costs by providing better information for management decisions and farm records essentials. Other important benefits are: less fuel use, less soil compaction, less hired labour requirement and more timely sowing. So, to farmers and land owners who decide to use technology to manage their fields, precision farming seems to bring many benefits, and ultimately increase of profit.

Keywords: Precision farming, environmental imbalance, sustainability.

EFFECT OF BIOEDIBLE COATING ON *Psidium guajava* TO ENHANCE THE SHELF LIFE AFTER POST HARVEST

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Psidium guajava L. is an important member of family Myrtaceae. Guava is a seasonal fruit that has been successfully grown all over India. The total area and production of guava is 22.7 lakh hectares. Major guava producing states are Uttar Pradesh, Bihar, Maharashtra, Karnataka, West Bengal, Andhra Pradesh and Tamil Nadu. There is huge post harvest loss that has been reported in guava. As guava is delicate fruit and its shelf life is less it is not easy to store and transport it for long time. Bioedible coating comprises of thin layers material that are appropriate for consumption and act as a barrier against different agents for example water vapor, oxygen, and moisture. They help to improve the quality as well as they extend the shelf life of fresh and processed fruits. The objective of this study was to slow down the activity of cell wall hydrolyses which are majorly responsible for ripening and spoilage of fruits. Guava is a seasonal climacteric sensitive fruit because it has high metabolic activity, its quality decreases rapidly after harvest. Salicylic acid, Calcium chloride, Oxalic acid and Chitosan are simple compound which is identified as plant growth regulator, as it has been effective on plant growth physiological processes. The cell wall hydrolysing enzyme that is Polygalacturonase, Cellulase and Pectin methylesterase assay was conducted on the bioedible coated and non coated guava to compare which bioedible coating has shown better shelf life. The results indicated that in non coated guava the activity of above mention enzymes increases progressively during the ripening but in coated fruits the activity of these enzymes decreased as compare to non coated guava during the ripening. Best result was shown by Chitosan followed by Salicylic acid, Oxalic acid and Calcium chloride.

Keywords:Bioedible, Salicylic acid, Chitosan, Oxalic acid, Calcium chloride

PLANT-GROWTH PROMOTING RHIZOBACTERIA (PGPR) PROMOTE PLANT GROWTH AND ALLEVIATE SALT STRESS IN *PISUMSATIVUM*

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Due to the increase in the worldwide population, the variety of the crop is lost due to various abiotic and biotic stresses, which limits global food production. The crops are losses due to biotic and abiotic stress. Abiotic stress includes salinity, drought, extreme temperature, heavy metals, etc. Biotic stress includes an attack by various pathogens such as fungi, bacteria, nematodes and herbivores. As plants are sessile, they have no choice to escape from these environmental cues. It is essential to increase agricultural productivity to feed an increasing population. Several tactics are needed, such as greater use of chemicals including fertilizers, insecticides, fungicides and herbicides to increase crop productivity. Plants have developed various mechanisms to overcome these threats of biotic and abiotic stresses. When the plants are exposed to an external stress environment, they generate an appropriate cellular response to overcome the stress. They do this by stimuli received from the sensors located on the cell surface or cytoplasm and transferred to the transcriptional machinery situated in the nucleus, with the help of various signal transduction pathways. The signaling pathways act as a connecting link between sensing the stress environment and generating an appropriate biochemical and physiological response. The most ecofriendly approach 'green technology' has been exploited for biofertilizer preparation. It can be improved by using stress-tolerant plant growth-promoting microorganisms. Plant growth-promoting rhizobacteria (PGPR) are a functionally diverse group of microbes having immense potential activity as bio-stimulants and stress alleviators. Their effective role in agroecosystems puts an eco-friendly and cost-effective alternative approach towards traditional chemical inputs that may positively affect agricultural productivity and environmental sustainability. These PGPR isolates can produce bioactive compounds such as gibberellins and Indole acetic acid ACC deaminase. The activity of antioxidant enzymes (ascorbate peroxidase, catalase and peroxidase), proline content, photosynthetic pigments and total antioxidative capacity also differed in the inoculated *P. sativum* plants. Thus the study revealed that the selected four rhizobacteria such as YS1_42, JH203, YS2_40 and 7R are good isolates to be explored and plant growth promoters. The isolates also possess the salt mitigating property, by regulating the osmolytes and antioxidant enzymes such as Superoxide dismutase, Catalase, Peroxidase, Photosynthetic pigments, Proline, Flavanoids and Phenols. PGPR also produced several active enzymes under drought, heavy metals, and salts stress. PGPR approach can enhance plant growth and consequently crop yield with a maintained eco-friendly environment. Hence we can conclude that the integrative use of this PGPR under salinity stress condition is an eco-friendly strategy for increasing the salinity tolerance in crop plants.

Keywords:-Environmental stresses, Cellular response and signaling, PGPR, Antioxidant enzymes.

USE OF CHITOSAN BASED BIOEDIBLE COATINGS TO REDUCE THE POST HARVEST LOSS OF AMLA (*Emblicaofficinalis*)

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The physicochemical characteristics and shelf life of (*Emblicaofficinalis*) amla fruits treated with different solutions like control (without Treatments), chitosan with tulsi extract, chitosan with green tea extract, chitosan with guava extract, chitosan with spinach extract, chitosan with paan. Coating of fruits with naturally derived compounds as chitosan with plant extract forming nanoparticles can reduce the post-harvest loss of fresh fruits and vegetables by preventing it from contamination with microbes especially fungi, which is main issue for post-harvest loss of fruits. All tested treatments indicated a significant delay in the change of weight loss, titrable acidity, total soluble solids, decaying percentage, sugar accumulation, chlorophyll degradation and carotenoids accumulation in amla fruits of experimental set than that of the control set. Post-harvest treatments of fruits can increase the availability of fruits for a comparatively longer period along with maintaining the biochemical and nutritional value of fruits. These treatments include various physical (UV ray/hot water), and biological treatments (antibiotic/yeast/bio control agent coating). Hence, it could be concluded that post-harvest treatment with bio edible has the potential to control decaying incidence, prolong the storage life and preserve valuable attributes of post-harvest amla. The disease incidence was calculated as percent inhibition on the basis of area infected as observed visibly in Treatments as compared to control. These coatings also have significant role in maintaining the quality of fruits by retaining the firmness of fruits and reducing the moisture loss as well as respiration rate.

Keywords: Amla, Treatments, UV ray/hot water, bio edible coatings.

NEED TO CONSERVE *Artemisia maritima* L.- A POSSIBLE FUTURE INBREEDER UMA BHARTI* AND NAMRATA SHARMA**

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Medicinal and aromatic plants are Nature's gift to human beings for pursuing a healthy life. *Artemisia maritima* L. a member of family Asteraceae falls in this category of medicinal plants. The species has gained its importance due to the presence of a drug called Santonin. The aerial parts of the plant also produce artemisinin; a potent source of an antimalarial drug. The aim of the present study was to evaluate the plant for its various medicinal properties and to identify the ways of its propagation. For this, attempts were made to elaborate the details of genetic system of the species growing naturally in Kishtwar Himalayas at an altitudinal range of about 1760masl. The species possesses a stable meiotic and mitotic system and exhibits a diploid chromosome number of $2n=18$. As far as the breeding system is concerned, the plant is an outcrosser and exhibits anemophily as well as entomophily. It produces an ample percentage of seeds on open pollination. In absence of outcrossing, the species keeps provision for selfing too in the form of dual pollen germination. In addition to the germination of pollen on the stigma, pollen germination occurs on ovule too; that helps to these plants maintain parental characters. Since the propagation of medicinal plants requires detailed knowledge of the ways they use for propagation and a logical way to conserve and propagate the best genotype identified among these. Maintenance of such genotypes is the need of future and present work covers details of the said work.

Keywords: Artemisia, breeding, genetic system, meiosis, propagation, conservation

BOOM OF DIGITAL LEARNING SOLUTIONS AND CHANGE IN AGRICULTURAL EDUCATION PROTOTYPE DURING COVID-19 PANDEMIC

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COVID-19 and the lockdown have hampered almost all the educational activities in India and worldwide, which resulted in the vagaries of the educational sector. Till 22nd September 2020, Over 31.4 million COVID-19 cases have been reported in the world. India is 2nd most populated and 2nd most COVID-19 affected country in the world with 5.56 million confirmed cases as per Arogya Setu App on 22nd September 2020. Six for *viz.*, Online Registration Platforms, Screen recording software, video conferencing software, Live streaming Platforms, e-Learning platforms and Remote Desktop Control Software are transforming the education system. Zoom and Google Meet have skyrocketed in demand during the lockdown, with each of them having their positive and negative aspect. Google meet conferencing service will be soon equipped with advanced moderation controls, and customizable backgrounds, a live noise cancellation feature, virtual background blur out or replacement options. G Suite for Education is enabling teachers and educators to have more control over their virtual classes' *viz.*, "knocking" interface with ceiling effect of two knocking, students won't be able to knock again after being removed of a class, while lets the host know someone, wants to join the meeting. Finally, anonymous participants will be prevented from entering any Education meetings by default, avoiding unwanted students from getting into a virtual class. During the meeting, hosts will be able to mute all participants, turn off the chat, and restrict who can present and prevents joining the meeting before the host is online. Google is also adding a hand raising feature, as well as a new video grid that can display up to 49 participants at once. In a nutshell, Boom of digital learning solutions has changed the educational prototype during COVID-19 pandemic.

Keywords: COVID-19, Live streaming Platforms, Online Registration Platforms, Screen recording software, Video conferencing software,

IMPACT OF COVID-19 ON HUMAN HEALTH AND INDIAN ECONOMY

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In present scenario, COVID-19 has drastically affected the entire population around the world. Its first case was found in Wuhan, China in December, 2019. In India this coronavirus become active in January 30, 2020, when a student traveled from Wuhan, China. He has successfully recovered from this infection on February 14, 2020. In India as of June 11, 2020 about 3, 05,951 persons were infected, out of which 1, 52,395 recovered and 1, 44,838 were still active along with 8718 deaths. This virus belongs to family Coronaviridae and infection mostly starts with respiratory discomfort. Still there is no medicine or vaccine available to cure this infection. Therefore, follow safety precautions and proper hygiene is only the way to keep a person healthy. Due to this pandemic, a lockdown of about 70 days was put by the Indian government. As a result all the industries, business and developmental activities remain closed and economy of India is drastically affected. In this review paper, a discussion has been made on the impact of COVID-19 on human health and Indian economy. These two issues (human health and Indian economy) are of great concern in the present scenario.

Key words- COVID-19, human health and Indian economy.

EFFECT OF STORAGE TEMPERATURE ON THE QUALITY OF FRESH-CUT TENDER JACKFRUIT

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Jackfruit (*Artocarpus heterophyllus* L.) is an important underutilized-fruits consumed in its tender form as a vegetable and popular for its flavor, color and meat like texture. In south Asian countries the tender jackfruit has a huge market potential to earn profits. To make available the tender jackfruit in the market, the present study was conducted to find out best storage condition for the fresh-cut tender jackfruit to extend its shelf life and edibility. For this, fresh-cut jackfruit slices were pretreated by dipping into 0.03% KMS and 1% CaCl₂ solution for 30 min followed by blanching in boiling water for 2 min. The blanched jackfruit slices were instantly cooled and surface dried and then wrapped with cling paper. Fresh-cut jackfruit kept at different storage temperature (3, 6, 9, 12, 15 and 22°C) maintaining the relative humidity of 85±5%. Different physicochemical parameters such as water activity, total acidity, total soluble solids, and antioxidant properties such as ascorbic acid, beta-carotene, total phenols and DPPH radical scavenging activity were evaluated and also the samples were visually observed throughout the storage period. Results revealed that all the physicochemical and antioxidants properties were differed significantly (P<0.05) among the fresh-cut jackfruit slices storage at different temperatures. It was found that samples stored at 22°C became spoiled at 2nd days of storage and samples stored at 15°C spoiled at 4th days of storage. Those sample were good and had edibility showed excellent nutritional quality especially in the retention of ascorbic acid, beta-carotene, total phenols and antioxidant activity. Results of this study concluded that the prepared fresh-cut tender jackfruit storage at 3° and 6°C is suitable to retain the nutritional quality and edibility up to 3 days.

Keywords: Tender jackfruit, Fresh-cut, storage conditions, nutritional quality, phenols, antioxidants.

DESIGN AND DEVELOPMENT OF INTEGRATED WAXING MACHINE FOR FRUITS AND VEGETABLE

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The aim of the present study was to design and development of an integrated semi-automated waxing machine for fruits and vegetables with a view to enhance the shelf life with improving quality at an ambient temperature. The fabricated machine comprised three basic units (such as washing, waxing and drying unit) which was made up of stainless steel. The dimension of washing and waxing unit were (1160 mm × 765 mm × 690 mm) while the drying unit was (1217 mm × 1310 mm × 420 mm). The washing unit facilitates both detergent wash and normal water wash with

horizontal 5 brush pad rollers and automated spray nozzles. Wax was coated with foam pad roller rubbing and spraying of wax onto the produces. The drying unit comprised of speed adjustable belt conveyors (1210 mm × 400 mm) and heating coil with blower fan for uniform temperature maintenance. To evaluate the machine performance, citrus fruits (Lemon, mandarin, sweet orange) and vegetables (tomato) were used for wax coating with carnauba wax on the surface of the produce. Results revealed that around 900 - 1000 fruits were waxed per hr. depending on the size and shape of the produce. The waxed sample was found to have shiny and glossy appearance with increased shelf life and market value comparatively to the controlled sample (without waxed). The operating cost of the designed small-scale integrated waxing machine was reasonable and economical for the entrepreneurs and small-scale processors to minimize the postharvest losses of the produces by timely and quickly processing.

Key Words: Small-scale waxing machine, Value addition, Postharvest loss, Quick processing.

EFFECT OF SEQUENTIAL AND TANK MIX HERBICIDES ON WEED DYNAMICS AND YIELD OF RAINFED MAIZE

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A field experiment was conducted Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during the years 2016-2017 and 2017-2018 to study the efficacy of sequential and/or tank mix herbicides for weed management in rainfed maize. The experiment was laid out in randomized block design with 3 replications. The treated consisting of different combinations of tembotrione, halosulfuron, atrazine, 2,4-D and mertibuzine as sequential or tank mix along with weed free and weedy check for comparison. The soil of the experiment was sandy loam in texture and slightly acidic in reaction, low in organic carbon and available nitrogen but medium in available phosphorus and potassium. The major weed flora observed maize crop experimental field were *Digiteriasanguinalis*, *Acrachneracemosa*, *Eragrostistenella*, *Physalis minima*, *Phyllanthus nururi*, *Solanum nigrum*, *Cynodondactylon*, *Amaranthus viridis*, *Echinochloacolonum*, *Eleusine aegyptium*, *Digitariasanguinalis*, *Cyperus rotundus* and *Cyperus iria* during both the years of experimentation. Among the herbicidal treatments, highest maize yield and lowest weed density and weed biomass were recorded in tembotrione 100 g/ha+atrazine 750 g/ha at 15-20 DAS which was statistically at par with tembotrione 100 g/ha+atrazine 500 g/ha at 15-20 DAS, atrazine 1000 g/ha+tembotrione 100 g/ha, tembotrione 100 g/ha+halosulfuron 67.5 g/ha at 15-20 DAS, tembotrione 100 g/ha+ halosulfuron 52.5 g/ha at 15-20 DAS and atrazine 1000 g/ha+ mertibuzin 250 g/ha. Also the highest benefit cost ratio was observed in tembotrione 100 g/ha+atrazine 500 g/ha at 15-20 DAS which was closely followed by tembotrione 100 g/ha+atrazine 750 g/ha at 15-20 DAS. Henceforth, based on the two years of investigation it can be safely concluded that tembotrione 100 g/ha+atrazine 500 g/ha at 15-20 DAS providing the best herbicidal weed management options under scarce labour availability in rainfed conditions of Jammu.

Key words: Rainfed maize, Sequential herbicides, tank mix herbicides, weed control efficiency, Yield

INCIDENCE OF INSECT-PESTS ON PULSES, CEREALS AND OIL SEEDS GROWN AS INTERCROP IN CASTOR IN SOUTH-WEST HARYANA

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An experiment on incidence of insect-pests on pulses, cereals and oilseeds as intercrop in castor was conducted at regional research station, Bawal, Haryana during Kharif 2019-20. In pulse moong beans, the mean percent damage due to incidence of insect pests was observed of hairy caterpillar (22%), thrips (10%), flea beetle (2.5%), jassid (12%), whitefly (6%), aphid (5.6%) and spotted podborer (11%). The mean percent damage caused by insect-pests in castor was 10.25%, 8.65%, 5.5%, 4.75%, 11.20%, 10.26% and 3.45% by the incidence of semilooper, hairy caterpillar, tobacco caterpillar, capsule borer, jassid, thrips and whitefly respectively. The mean percent damage in oilseed sesame (til) due to the incidence of hairy caterpillar, jassid, whitefly and til hawk moth was 4.75%, 5.25%, 5.55% and 5.20% respectively. In cereal pearl millet, the mean percent damage due to incidence of insect pests was 5.55% of white grub, 1.75% of hairy caterpillar and 2.5% of grey weevils. Maximum incidence of insect pests was observed in castor crop while minimum incidence was in the pearl millet of cereal crop.

Keywords: Intercrop, insect-pest, incidence, percent damage.

EFFECT OF TEXTILE INDUSTRY WASTE WATER ON SOIL MICROBIAL POPULATION

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The textile industry is one of the world's most pollution generating industries and management of its toxic effluent has become a global issue. However, the use of textile effluent as a source of nutrients can be a viable option due to the presence of some essential minerals, although the presence of several toxic elements can deteriorate soil health. Therefore, experiments were conducted to identify the potential of textile effluent amendment of soil to increase the microbial population for agricultural sustainability. In this study, soil was fertilized with different concentrations of textile effluents (i.e. 0, 10, 20, 50 and 100%) to accurately. The results indicated that lower concentrations of textile effluent were a good source of microbial population whereas higher concentrations of it were deteriorating soil health. Total number of bacteria, free-living diazotrophs, actinomycetes and fungi increased with increase in the concentration of waste water upto 20% level. After 60 days of incubation, microbial population increased significantly upto 20% concentration of textile waste water amendments and then declined on further incubation showing that textile waste water is being utilized as nutritive source upto 20% at initial stages of incubation, however microbial population was decreased on further increasing the waste water concentrations (20 to 100%) indicating damaging effects of waste water on soil health.

Key words: Industry, Microbial population, Soil health, Waste water

RICE (*Oryza sativa* L.) YIELD AND GROWTH PARAMETER AS INFLUENCED BY PLANTING TIME AND NITROGEN APPLICATION

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A field experiment on rice crop was conducted during *kharif* season of 2017 and 2018 at Rice Research Station, Kaul (Kaithal) of CCS Haryana Agricultural University, Hisar to find out effect of two different doses of nitrogen application on growth parameters and yield of rice under timely and late transplanting. The experiment consisted of three transplanting dates (P₁: 3rd week of June, P₂: 1st week of July, P₃: 3rd week of July) with two levels of N application (120 and 150 kg N/ha) on different time. Experiment was laid out in split-plot design with transplanting dates in main plot and N levels in sub-main plots. Results showed that crop growth parameters viz. plant height, number of tillers/m² and dry matter accumulation were reduced significantly under late planting (P₃). The crop yield attributes (number of panicles/m² and grains/panicle) and grain yield of were at par under earlier planting (P₁ and P₂) but reduced significantly under late transplanting (P₃). The yield attributes and yield (grain and straw) of the crop increased with increase in N application rates but the response was significant for 150 kg N/ha. Interaction between transplanting time and N application levels was found significant in respect of grain yield/ha which revealed that a dose of 150 kg N/ha was sufficient in rice transplanted early (up to 1st week of July) whereas the late transplanted (3rd week of July) crop may be supplied with higher dose of N to get higher yield. The highest yield was, however, obtained with the crop transplanted early (up to 1st week of July) and supplied with 150 kg N/ha.

Keywords: Transplanting dates, nitrogen fertilizer, growth parameters, yield

CONCEPTS AND APPLICATION OF SIMULATING WATER DYNAMICS IN SOIL-PLANT SYSTEM

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Soil water balance processes include infiltration of rainfall and irrigation, runoff, soil evaporation, crop transpiration, root water uptake from the various soil layers, and drainage of water from the soil profile below the root zone. Evapotranspiration and leaching are the main sinks of water. Process-based simulation models of complex systems such as the soil-plant-atmosphere continuum are invaluable tools for this purpose. Modeling approach required a comprehensive understanding of the complex interactions between canopy architecture, plant processes, soil-water mechanisms, and the long-term impact of weather patterns. Modeling of root water uptake by plant is a difficult task, particularly across a country like India having such diverse agro-climatic conditions. Comparing model results with field observations provides information on model performance. There are various model used for the simulation of crop and water balance for eg. HYDRUS-1D, SEM, DSSAT, WHCNS, Coupling of DSSAT and HYDRUS. Coupled models provide satisfactory simulations of soil water content change as well as plant growth. The water uptake by plant roots has been simulated both at the microscopic and macroscopic levels and microscopic approach requires detailed information about the dynamic geometry of the plant root system that is practically not available. Soil water dynamics at the field scale have been described through simple empirical

and complex process-based models. For evaluating model performance criteria, four statistical indices were used to evaluate the performance of each model in simulating the observed data. The mean bias error (ME), root mean squared error (RMSE), Index of agreement (IA), Modeling efficiency according to Nash and Sutcliffe (NSE). Model with low value of mean bias error (ME), RMSE and high value of IA and NSE fit for the prediction.

Key word: Modeling, soil water balance, soil plant system

EVALUATION OF DIFFERENT VARIETIES AND FERTILIZATION ON GROWTH AND YIELD IN DUAL PURPOSE OF WHEAT

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Wheat is most important staple food crop of the world. Dual purpose wheat *i.e.* for grain as well as for green fodder purpose is a novel concept in world. With the view of this concept, present experiment was carried out to evaluate tall and dwarf wheat (*Triticum aestivum* L.) cultivars for dual purpose under different seed and fertilizer level. Experiment was conducted at Research farm of Department of Agronomy, CCSHAU, Hisar during *rabi* season of the year 2017-18 and 2018-19. The field experiment was conducted in split plot design with two wheat cultivars *i.e.* C 306 and WH 1105 taken in main plot with cut and no-cut management and two seed rates (100 kg & 125 kg/ha) with three fertilizer levels [100%, 115% and 130% recommended dose of fertilizers (RDF)] in sub plot. From the study, it was found that significantly higher dry matter accumulation, crop growth rate (CGR), total tillers, effective tillers, spike length and number of grains/spike at harvest were recorded in WH 1105 over C 306. Whereas, significantly higher plant height and LAI was recorded in C 306 over WH 1105 during both the years sown at either seed rate or fertilizer levels. Significant increase in growth parameters and yield attributes was recorded in both wheat cultivars when fertilizer dose increased from 100 per cent RDF to 130 per cent, being at par with 115 per cent RDF. Due to fodder cut at 60 days after sowing (DAS), significant reduction in growth parameters of both the cultivars was observed but grain yield of C 306 was not much affected significantly due to fodder cut when supplied with higher fertilizer dose of 115 per cent RDF and 130 per cent RDF even with recommended seed rate.

Key words: Wheat, cut management, dual purpose, C 306 and WH 1105

IMPACT OF WEATHER PARAMETERS ON RICE YIELD IN KARNAL DISTRICT

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The analysis was conducted for Haryana district of Karnal for a period of 35 years (1980-81 to 2015-16), based on historical data. Rice yield data were taken from Haryana's Statistical Abstract and corresponding daily weather data from the Central Soil Salinity Research Institute (CSSRI), Karnal were collected. With yield as dependent variable and weather indices (artificial variables created from weekly & fortnightly weather values) both individually and in combinations, were used as predictor variables in stepwise multiple regression technique. The data for the period 1981-82 to 2012-13 were used for model development, and the remaining three years of data, *i.e.* from 2013-14 to 2015-16, were used for validation. Depending on the Root Mean Square Error (RMSE) and the adjusted R^2 , the model is chosen among all models based on the number of rainy days (24

weeks) relying on individual weather variables. The model based on the cumulative effects of maximum temperature and relative humidity morning (22 weeks) predicted rice yields that were very similar to real yields as a per-cent relative deviation from 1.15% to 7.6%.

Key words: Coefficient of determination, Forecasting, Rice, Root Mean Square Error, Standard Error

DEVELOPMENT OF WEATHER BASED MODELS AND SIMULATION FOR PRE-HARVEST MUSTARD YIELD FORECASTING IN HARYANA

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The study aims at developing weather-yield models following multiple linear regression for mustard yield forecasting in Bhiwani, Fatehabad, Hisar, Sirsa, Gurugram, Jhajjar and Mahendragarh districts of Haryana. The fitted models are based on weather parameters viz., maximum temperature, minimum temperature and rainfall along with crop condition term (CCT) as categorical/dummy regressor(s). The post-sample validity assessment of the developed model has been verified by determining prediction errors using root mean square errors and average absolute percent relative deviations. Incorporating CCT as categorical covariate along with weather parameters enhanced the predictive accuracy of weather-yield models in spite of showing lower adj. R^2 and higher standard error of estimate. Student's t copula procedure in SAS is used to simulate the mustard yield achieved from weather+CCT based regression model. The forecasts obtained from regression-based weather+CCT model being remarkably close to the forecasts obtained through the simulation process indicate the preference of using developed models for pre-harvest mustard yield forecasting in Haryana.

Key words: Root mean square errors (RMSEs), Crop Condition Term (CCT), Simulation, Dummy variable and Mustard yield forecasts

ANTIMICROBIAL ACTIVITY OF INDIAN SPICES

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Spice is plant substance like seeds, fruits, bark, stems, roots, flowers, leaves and etc which help in flavoring, essence and coloring food and beverages. Spices have nutritional value, rich in antioxidant property and useful for health benefit. It is rich in minerals (like calcium, potassium, sodium, copper, zinc, magnesium, iron and etc) and vitamins which help in improve immunity system, reduce damage body cells, and balance hormonal disorder, improving digestive system and anti-inflammation. Spices used in medicine formation, cosmetic and perfume productions. Spices like turmeric, cinnamon, cloves, and cumin have antibacterial and antifungal activity against food spoilage microbes like *Aspergillus flavous*, *Bacillus subtilis*, *Pseudomonas fluorescens*, *Staphylococcus aureus*, *Escherichia coli* and *Vibrio parahaemolyticus*. It helps to prevent in growth of food spoilage microbes or inhibit the growth of food spoilage microbes. Spices have a great potential to be worked as antimicrobial agents. Methanol, ethanol and double distilled water used in extraction of spices for solubility test. Further experiments with food borne pathogens are in process to find out their bio-preservative value.

Keywords: Biopreservative, Antifungal, Antibacterial, Extraction, Antioxidant

YIELD EFFECT ON SUCCEEDING LENTIL UNDER RICE BASED CROPPING PATTERN DUE TO DIFFERENT TRANSPLANTING DATES

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An experiment was conducted at the instructional farm of Uttar Banga Krishi Vishwavidyalaya located at Pundibari, Cooch Behar, West Bengal which was laid out in split plot design with 3 different dates of transplanting viz. D₁: 10th July, D₂: 25th July and D₃: 10th August in main plots and 4 varieties viz. Tulaippanji, Khasa, Gobindobhog and Kalonunia in sub plots. The two years average data showed that the crop transplanted on 10th July improved growth attributes (plant height, DMA, LAI, SPAD value), yield parameters (numbers of panicle m⁻², numbers of grain panicle⁻¹, 1000 grain weight), Yield (Grain and straw) of aromatic rice irrespective of the varieties. However, minimum growth parameters were recorded in crop transplanted on 10th August. Data of growth parameter among the varieties in all the stages shows that plant height and Crop growth rate was found highest with the variety Gobindobhog which was followed by Khasa varieties whereas the maximum Dry matter accumulation, Leaf Area Index and Spad value was observed under Khasa varieties which are at par with Gobindobhog. In respect of yield attributing characters, number of tillers m⁻² (306), numbers of panicle m⁻² (240), numbers of filled grain panicle⁻¹ (138.68), 1000 grain weight (21.87 g), grain yield (2.38 t ha⁻¹) and Harvest Index (31.51 %), Khasa variety performed better. Growth parameters and grain yield of residual effect of succeeding lentil crop was observed maximum in plots transplanted at 10th July. However, Kalonunia variety transplanted plot recorded highest grain yield (1.135 t ha⁻¹) which was at par with Khasa variety plot (1.131 t ha⁻¹). Hence, transplanting on 10th July may be most suitable in Terai region of West Bengal for obtaining better yield under rice based lentil cropping system.

Keywords: Aromatic rice, date of transplanting, varieties, growth, yield, succeeding crop

COMPARATIVE PERFORMANCE OF TUBEROSE GENOTYPES IN THE SUB-HIMALAYAN TERAJ REGION OF WEST BENGAL

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An experiment was conducted at the experimental farm of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal at the Department of Floriculture, Medicinal and Aromatic Plants, in 2013-2014 and 2014-2015 to identify the suitable cultivar of Tuberose for Sub-Himalayan Terai region of West Bengal. For this experiment, seven different Tuberose cultivars namely Suvasini, Vaibhav, Calcutta Double, Phule Rajni, Prajwal, Calcutta Single and Shringar were used

wherein the cultivars showed distinct performance regarding various growths and yield attributes. Results revealed that the cultivar Calcutta Double recorded better performance in respects of plant height and leaf production at monthly intervals. Earlier sprouting (9.32 days) of bulbs was observed with cultivar Calcutta Double and the same cultivar also showed earliness in flowering (80.97 days), more number of florets per spike (46.30) with greater diameter of both florets and spikes (0.95 cm). Higher fresh (114.60 g and 141.18 g) and dry weights (23.16 g and 17.91 g) of florets and cut spikes as well as improved field-life (17.04 days) and vase-life (8.29 days) of spikes were obtained from the same Tuberose cultivar Calcutta Double along which the month wise data and annual data (45.66) for flower production was also found maximum with the same cultivar. Therefore, cultivar Calcutta Double showed better performance in growth and flowering in open field cultivation in Sub-Himalayan Terai region of West Bengal and hence maybe recommended for commercial cultivation in this region for cut flower production.

Keywords: Tuberose, comparative, cultivars, growth parameters, yield parameters

EFFECT OF NUTRIENTS AND FOLIAR APPLICATION GROWTH AND YIELD OF FOXTAIL MILLET (*Seteria italic .L*)

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The study was conducted during *kharif* 2018 and *kharif* 2019 at ICAR- Krishi Vigyan Kendra, Haveri to evaluate the response of foxtail millet (*Seteria italic .L*) to soil application of micronutrients and foliar application of NPK along with RDF. The experiment was laid out in RCBD comprising of nine treatments replicated thrice. Studies revealed that the growth parameters, yield attributes and grain yield of foxtail millet differed significantly due to foliar application of NPK along with RDF and soil application of micronutrients along with RDF. The results indicated that significantly higher grain yield (18.49 q ha⁻¹) and straw yield (36.14 q ha⁻¹) of foxtail millet were recorded in treatment applied with RDF + foliar spray of 19:19:19 @ 1% at flower initiation stage (pooled data of 2 years) followed by soil application of micronutrients along with RDF. The treatment RDF + foliar spray of 19:19:19 @ 1% at flower initiation stage recorded significantly higher plant height (92.50 cm), panicle length (22.27 cm) and grain weight per panicle (2.80 g). The biological yield and nutrient uptake (NPK, Zn and Fe) are also significantly higher with the same treatment. The gross returns, net returns and BC ratio were also higher with the same treatments (Rs.48284, Rs.32036 and 2.97, respectively) as compared to all other treatments and absolute control.

Keywords: Foxtail millet, iron, zinc, foliar NPK, nutrient uptake, growth and yield

ADOPTION OF MODERN TECHNOLOGIES IN DAIRY ENTERPRISE FOR ENHANCING THE INCOME OF RURAL WOMEN

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Dairy farming is one of the important enterprises which dominate the economic activities of the woman in the rural areas of India. Increasing demand for milk and milk products in recent years

intensifies dairy farming as profitable enterprise for rural woman. Most of the activities of dairy farm were carried out by women so they spent more time compared to men in dairy production. Women spent about 294.34 min. daily in different dairy farm activities like feeding, watering, milking, housing, breeding, animal health care and marketing (John Christy and Thirunavukkarasu, 2002). Most of the tasks performed by women are tedious as well as time consuming. As most of these operation are done manually (using hand, foot or head) or by using traditional tools, they are slow and cause considerable fatigue and drudgery. All these factors result in physical and mental fatigue, monetary hardship, exploitation, pain, economic stress etc. There are growing number of available technologies which can enhance women's productivity and income in animal husbandry sector. Higher level of technology adoption is associated with better milk yield and improved dairying has a direct impact on milk yield and household's income generation as well as dairy development.

Key Words: Dairy farming, fatigue, technologies, income.

MITIGATION OF DROUGHT STRESS IN MUNGBEAN (*Vigna radiata* L. WILCZEK) USING RHIZOBIAL STRAINS

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A field experiment was conducted during *kharif* season 2016 at Crop Physiology Area, CCS Haryana Agricultural University, Hisar, India with the objectives to assess the mitigating effect of different *rhizobial* strains on physiological and biochemical traits in mungbean and to measure the association of these traits with crop performance under drought condition. Crop was raised under optimum conditions (irrigated) or drought stress without any post sowing irrigation (rainfed conditions). The experimental treatments consisting of (a) without inoculation (only RDF) and (b) with inoculation (RDF with combination of five *rhizobial* strains viz. *Vigna* 703 + PSB strain P-36, MR 63, MR 54, MB 17a and MH 8b2). The measurement of chlorophyll fluorescence (Fv/Fm), membrane stability index (MSI%), chlorophyll content, canopy temperature depression (CTD) were done at 50% flowering, which were found to be decreased by 16.3%, 17.7 %, 2.9% and 88%, respectively under drought stress. The plants inoculated with *rhizobial* isolate MR63 and MB 17a showed greater Fv/Fm (18.7% and 15.9%), MSI% (19.4% and 17.9%), chlorophyll content (20.2% and 16.2%) and CTD (151.3% and 104.8%) respectively over RDF. Significant positive correlation was observed among seed yield and MSI (%); seed yield and chlorophyll fluorescence. CTD has a significant negative correlation with chlorophyll content and seed yield.

Key words: - drought, mungbean, *rhizobia*, yield

TILAPIA LAKE VIRUS (TiLV) DISEASE: CURRENT STATUS OF UNDERSTANDING NILAV AICH¹, ANIRBAN PAUL², TANMOY GON CHOUHURY^{3*}

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Tilapia Lake Virus (TiLV) disease is an emerging and transboundary disease of tilapia cultures, causing mortality up to 90% globally. TiLV is a negative sense single stranded RNA virus belongs to family *Amnoonviridae*, genus *Tilapinevirus* and species *Tilapia tilapinevirus*. The first TiLV outbreak to fishes was reported from Israel followed by other countries viz., Ecuador, Colombia, Egypt, Thailand, Chinese Taipei, India, Malaysia, Bangladesh, Uganda, Tanzania, Peru, Mexico, Philippines, Indonesia and USA. All the life stages of Tilapia (belonging to the family

Cichlidae) are vulnerable to TiLV infection. However, river barb and giant gourami has also been found susceptible for TiLV infection. The virus infects the vital organs of the fish including eyes, brain and liver. Notable pathological finding includes syncytial cell formation and massive hepatocellular necrosis with pyknotic and karyolytic nuclei in the liver cells of infected fish. The disease is very contagious in nature and spreads through both horizontal and vertical transmission. Several sensitive and rapid molecular diagnostic tools like reverse transcriptase polymerase chain reaction (RT-PCR), RT-quantitative PCR (RT-qPCR), loop mediated isothermal amplification (LAMP) have been developed for early detection of the virus. Till date, no comprehensive control measures have been developed throughout the globe although aggressive work on this line is going on. Implementations of strict good management practices including quarantine protocols are the only available option to combat the outbreak and spread of the disease. This review emphasizes about the etiology, occurrence and distribution, mode of transmission, pathology and pathogenesis, diagnosis and possible control measures and challenges of TiLV disease.

Keywords: Co-habitation; Diagnosis; *Tilapinevirus*; Syncytial

BIOLOGICAL DEGRADATION OF POLLYTHENE

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Plastic wastes accumulating in the environment are posing an ever increasing ecological threat. Plastics that are biodegradable can be considered environment friendly, they have an increasing range of potential application and are driven by the growing use of plastics in packaging. In this study, the biodegradation of polythene bag was set to analyze, microbial counts. The efficacies of microbes in the degradation of plastics were analyzed in the cultures for more than 2 month compared to others. The study is to analyze the potential of bacteria in degrading the plastics. The research can be of great use in further future to safeguard the environment.

Keywords: plastic degradation, bacteria

EFFECTS OF PLANT GROWTH REGULATORS ON IN-VITRO CALLUS INITIATION OF ELAEOCARPUS GANITRUS (RUDRAKSH)

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Elaeocarpus ganitrus (Roxb.) is a tree species belonging to the family of *Elaeocarpaceae*. The present study deals with the effects of growth regulators on in-vitro callus initiation of *E. ganitrus*. Explants like leaves, stem etc. were collected from the trees. Different media like MS (Murashige and Skoog) medium, Anderson medium, WPM (Woody Plant Medium) were used. Plant growth regulators (PGRs) were taken at different concentrations separately and in combination in all the three media. Initiations of callus were observed on all the three media at specific concentration of PGR.

Key words: Callus, Explants, PGRs

PREPARATION OF DIFFERENT TYPES OF VINEGARS USING SOME FRUITS JUICES

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Vinegar contains trace vitamins, mineral salt, amino acids and polyphenolic compounds. Vinegar is produced from raw materials containing starch or sugar via sequential ethanol and acetic acid fermentation and is used in variety of food applications. Vinegar can accelerate the solubilisation of calcium, iron, and phosphorus in vegetables and retracts the loss of vitamin. It can improve the absorption of nutrients for human body. In the present study we used apple, sugarcane, guava, black grapes, white grapes, pineapple for preparation of vinegar. These were crushed to extract the juice and were diluted with distilled water to obtain 2-3% (w/v) concentration of free sugar. These were then incubated at room temperature for 3-4 weeks and then filtered through 4-layers of muslin cloth and the procedure was repeated 2-3 times until the clear supernatant was obtained. Thereafter the filtration was incubated with mother culture of Acetobacter under aerobic conditions for further 3-4 month until good smell of vinegar was produced. The contents were centrifuged at 10000 x g to obtain clear supernatant. Spectrophotric analysis at 237, 254, 280 and 465 nm were measured as the data were interpreted. Further experiments with food borne pathogens are in process to find out their bio-preservative value. The effect of vinegar treatment of nutritive value of common eatable will also be assessed.

Keywords: Vinegar, Obligate aerobes, Acetobacter, Oxidase, Catlase, nutritive value

STUDIES ON EFFECT OF VEGETARIAN AND NON-VEGETARIAN DIETS ON ORAL MICROBIOTA OF HUMANS

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The environment of human mouth is suited to the growth of characteristic micro-organisms. It provides a good source of water, nutrients, and moderate temperature. Human saliva is an extracellular fluid produced and secreted by salivary glands in the mouth. Human saliva is a complex fluid, which influences oral health through specific and nonspecific physical and chemical properties. In the present study, Dietary effects on the oral microbial community by examining the diversity, composition, and functional potential of the salivary microbiota. Human saliva is evaluated against clinically important bacteria. The biological activities of three of the main enzymes of saliva are measured using appropriate enzymes assay in both groups. **Keywords:** Enzyme activity, Human saliva, microbiota

SURVEY ON INCIDENCE OF THE POD ROT OF GROUNDNUT (*Arachis hypogaea* L.) IN CHITTOOR AND ANANTAPUR DISTRICTS OF ANDHRA PRADESH

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Pod rot of groundnut is a complex and economically important disease causing severe damage to groundnut production. The disease being soil borne in nature and symptom expression occurring inside the soil from flowering to pod stage generally escape the notice of the farmers resulting in huge yield losses. Hence, a roving survey was conducted on the incidence of pod rot disease of groundnut during *kharif*-2017 in major groundnut growing mandals of Chittoor and Anantapur districts in Rayalaseema region of Andhra Pradesh. The mean disease incidence varied from 11.4 per cent to 28.6 per cent in Chittoor district and from 8.5 per cent to 30.0 per cent in Anantapur districts. Isolation of pathogens associated with the diseased samples revealed the occurrence of *Fusarium* spp., *Rhizoctonia bataticola* and *Sclerotium rolfsii*.

Keywords: *Fusarium*, Oilseed, Rhizosphere, *Rhizoctonia*, *Sclerotium*

**IMPACT OF DIFFERENT SOWING DATE ON PERFORMANCE OF MAIZE UNDER
CHANGING CLIMATIC SCENARIO**

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Maize (*Zea mays* L) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest yield potential among the cereal. Maize has third important cereal crop in India among rice and wheat crop. In India, maize is used in various form as human food (23%), poultry feed (51%), animal feed (12 %), industrial (starch) products (12%), beverages and seed (1% each). It requires 50-100 cm of rainfall and it cannot be grown in areas of more than 100 cm rainfall. Cool and dry weather helps in ripening of the grain. This crop usually grows well under temperatures varying from 21°C to 27°C, although it can tolerate temperatures as high as 35°C and frost is also injurious to maize and this crop is grown only in those areas where there are about four and a half frost free months in a year. But in Koshi region the temperature varies from 4°C to 44°C and due to affect of temperature the cultivators of late sowing maize cannot achieve optimum yield. Keeping these facts in mind the present investigation was carried out at farmer field of Katihar district during in two consecutive years 2013-14 and 2014-15 for impact of different sowing date on performance of Maize under changing climatic scenario". The soil is light gray flood plain belongs to the alluvial gangetic plain (Agro climatic zone II) with the pH 6.54, E_{Ce} 0.18 d Sm⁻¹, OC 0.25 %, available N, P and K 221, 18 and 231 kg ha⁻¹, respectively. In this study the maize cereal crop incorporated with the treatments T₁ – Farmer Practices (15 to 25 October), T₂ – 25 October to 05 November and T₃ – 05 November to 15 November. The experiment was laid out in RBD with above three treatments and eight replications. To evaluate the observation regarding growth attributes and yield components of individual plant parameters. Results indicated that the sowing of maize from 05

November to 15 November (T₃) achieved maximum yield (74.79 q/ha) in comparison to other treatment T₂- 25 October to 05 November (73.25 q/ha) and farmer practices T₁- 15 to 25 October (68.7 q/ha). Hence, the benefit cost ratio also increase from farmer practices 15 to 25 October (3.65) to 4.11 in (T₃) 05 November to 15 November sowing crop and 4.03 in 25 October to 05 November T₂. Hence, in the sowing of maize crop in these climatic conditions at different time in order to quantify that the impact of changing climate on maize yield and yield parameters sowing time of rabi maize at 10 November produces better result in term of yield and economics.

Key words: climate change, *rabi* maize, temperature, date of sowing

CONSERVATION AGRICULTURE: A NEW PARADIGM FARMING FOR 21ST CENTURY

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The global evidences show that present conventional farming practices need of transformation for improving food security, environmental preservation and enhancing livelihood should be the main targets of today's and 21st century farming systems sustainability. Conservation agriculture (CA), based on minimum tillage, crop residue retention, and crop rotations has been proposed as an alternative system combining benefits for the farmer with advantages for the society. Conservation agriculture (CA) changes soil properties and processes compared to conventional agriculture. These changes can, in turn, affect the delivery of ecosystem services, including climate regulation through carbon sequestration and greenhouse gas emissions, and regulation and provision of water through soil physical, chemical and biological properties. Conservation agriculture can also affect the underlying biodiversity that supports many ecosystem services. There is clear evidence that topsoil organic matter increases with conservation agriculture and with CA other soil properties and processes that reduce erosion and runoff and increase water quality so that CA is widely promoted for reducing soil degradation and improving agricultural sustainability. CA as a production-enhancing set of practices is suitable for Indian agriculture systems where many farms are small and marginal only. Agriculture in the next decade will have to sustainably produce more food from less land through more efficient use of natural resources and with minimal impact on the environment in order to meet growing population demands. In this review paper we conclude the potentials of conservation agriculture and lags for farmer adaptation.

Keywords: conservation agriculture; sustainability; ecosystem services; run- off; potentials

STUDY ON GROWTH PERFORMANCE OF CROSSBRED KIDS THROUGH FEEDING OF HYDROPONIC GREEN FODDER

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Goat farming is an important occupation as it sustains livelihood security of the farmers through modern goat farming at present. Goats are raised principally for their meat, milk, fibre and skin. Goats efficiently convert sub quality grazing matter into quality lean meat. Due to limited availability of grazing land farmers are interested to rear goat farming in intensive system through feeding of hydroponic green fodder. Boer breed is an important exotic breed reared in many part of the country & abroad and famous for its meat due to better growth rate & survivality. Therefore, A study was conducted to know the growth performance of crossbred kids (Black Bengal X Boer) produced through artificial insemination technique in Black Bengal goat using Boer frozen semen at Goat Farm, Animal Production Research Institute (APRI), Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar). For this study 10 crossbred kids were used as experimental animals. The kids were feed with hydroponic maize green fodder ad libitum on 30th days onward with maintaining the standard managerial practices. Thus, It was found that crossbred progeny recorded superior body weight at 3 months and 6 months of age as well as daily weight gain with better health.

Keywords: Boer crossbred kids, growth rate, survivality, hydroponic maize fodder.

HERBAL AND TRADITIONAL MEDICINES: A HOPE FOR BETTER FUTURE IN THE PAST

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The success of human race has been tremendously impacted by their tendency to explore the nature and learning to extract benefit from available resources in its milieu. The apprehension of pharmacological value lies in the flora, an invaluable offering by nature, marks a key landmark to the advancement in healthcare. This spawned the discipline of herbal and traditional medicines. The domain of herbal medicines, typically, aims to practice the medicinal value of plants in the welfare of biological world. Its advent has served authoritatively to furnish tremendous value to upgrade the facet of health for centuries¹. The comprehension, skills and practices exercised in the sphere of traditional medicines are greatly shaped in context of the culture, spatiotemporal domains and environment in which it evolves. This subjective nature of traditional medicines, indeed, promises a personalised approach in treatment, which forms a central stage to the therapeutics². The core philosophy that underpins the exercise of traditional medicines is its holistic perspective to health as a delicate balance of three components; mind, body and the environment. This renders the attention to restore the overall health rather than suppressing/treating specific illness in question. This distinguishing feature renders it stand out from other contemporary medical practices². The herbal practitioners, typically, employs crude plant extracts in medicines. This makes the traditional medicines a blend of multiple constituents, which has been claimed to synergise/boost the effect and dampen the toxicity posed by infusion of individual ingredients. Apparently, the toxicity associated with several plants may present ill-effects to health^{1,2}. We are surrounded by myriad of herbal medicines like ginger, garlic, turmeric etc. to name a few. These routinely encountered herbal

elements exhibit enormous health benefits for which there exists a mass unawareness³. The herbal medicines need to be popularize to common people to dispense them with an affordable and accessible means of healthcare. The advancement in medicinal sciences has greatly dwarfed the therapeutic appreciation of herbs that were traditionally being employed in treatment of diverse range of ailments. Despite the modernisation and progression of pharmacological industry, the world-wide demand for herbal medicines is still surging substantially. It propounds that the reliability and faith to herbal treatment is still prospering in the treatment practices¹. The herbal medicines have surfaced as a ray of hope in fighting against many pandemic illnesses. Lately, WHO endorsed the testing of herbal medicines as a potential treatment to the COVID-19 infection, which advocates their vitality in therapeutics⁴. The herbal and traditional medicines have always been an affordable, accessible and a personalised health care approach and likely to remain so in future. The herbal treatment should be encouraged by government to flourish in harmony with conventional medicines to mount a better future to medical science.

CERTIFICATION OF ORGANIC PRODUCTS IN INDIA
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India Organic is a certification mark produced in India for organically farmed food products. The certification mark certifies that an organic food product conforms to the National Standards for Organic Product established in 2000. A trademark-" India Organic "will be issued in accordance with the National Standard for Organic Productions (NSOP). Communicating the genuineness and origin of the drug, this trademark will be the property of the Indian Government. These standards ensure that the product or the raw materials used in the product were grown by organic farming without the use of chemical fertilizers , pesticides or hormones induced. The certification is provided through test centers approved by the Agricultural and Processed Food Products Export Development Authority (APEDA), under the Government of India 's National Organic Production Program. Although the standards have been in effect since 2000, the certification scheme and therefore the certification mark came into being in 2002. In December 2017, the Food Safety and Standards Authority of India (FSSAI) introduced the Jaivik Bharat logo to help customers identify authentic organic foods just like green & red dots on products to signify if they are vegetarian or non-vegetarian. The National Organic Production Program (NPOP) is introduced by the Government of India. The national system includes the certification bodies accreditation scheme, organic production requirements, promotion of organic farming etc. European Commission and Switzerland have recognized the NPOP standards for the production and accreditation system for unprocessed plant products as being equivalent to their country standards. Similarly, USDA has acknowledged NPOP accreditation conformity assessment procedures as equivalent to US accreditation. With these recognitions, the importing countries accept Indian organic products which are duly certified by India's accredited certification bodies.

Keywords: Organic, Certification, NSOP, APEDA and Jaivik Bharat.

PULSES AS A KEY ELEMENT FOR DOUBLING FARMERS' INCOME
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Pulses form an important component of basic Indian diet. These are consumed prepared as a curry called 'dal' that is an important source of dietary proteins for Indians. They are widely acknowledged as super foods with double the protein in wheat and three-fold that in rice. Besides, they are also rich source of complex carbohydrates, micro-nutrients, B-vitamins and minerals. Long shelf-life without loss of nutritional value, low prices coupled with wider availability make pulses an affordable source of protein and minerals and contribute to food security at all levels of society in India. Besides adding to the human nutrition, pulse crops serve as a source of fodder and fuel for the farm-families. Pulses are the crops endowed with the virtues of efficient utilization of available limited soil moisture and nutrients as well as producing beneficial impact on physical chemical and biological properties of soil which are basic for a sustainable crop production system. These crops not only fix the atmospheric nitrogen for their growth and thereby reducing the dependence on external source of nitrogen. They also contribute towards increasing the availability of nitrogen for subsequent crop through residual effect, due of this pulses are rightly termed as mini nitrogen-factories. Crop rotation with pulse crops helps in sustainably enhancing overall productivity and profitability of the cropping system. The system with pulses also favours decreasing the risk of plant diseases and use of pesticides. Their integration in the crop rotation with cereals also helps in breaking the pest cycles, thereby contributing to improvement in the overall system productivity. Pulses work as a cover crops. Inclusion of pulses in crop rotations reduces the risks of soil erosion and depletion. Pulses contribute significantly towards higher rates of accumulation of soil carbon than cereals or grasses and pulses inclusive crop rotations have a higher soil carbon sequestration potential than that of mono cropping systems.

So, Pulses as a key element for doubling farmers' income through diminishing cost of production, increasing per unit productivity, efficient marketing networks and successful technology delivery mechanisms by giving emphasis sustainable intensification and crop diversification, climate resilient production technologies.

Keywords: Income, Pulses, Farmer, Cropping system and Productivity.

DIALYSIS INDUCED HYPOGLYCEMIA IN ON NON-DIABETIC CHRONIC KIDNEY DISEASE PATIENTS

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The observational clinical study was undertaken in 50 patients reported by the dialysis center, competent and able to be evaluated, classified into two groups of fasting and postprandial CKD-5 patients. This longitudinal observational research was performed in 48 consecutive CKD patients (male and female) at MLB, Medical College, Jhansi, India, from March 2016 to November 2018. After a short night, 5 ml of venous blood samples were obtained in transparent tubes. After selection, the samples were allowed to clot for half an hour during which the samples were centrifuged, and the serum was examined in the automated biochemical analyzer Selectra Pro M at the ISO 2015:2000 accredited Pathology Laboratory in the Medical College. In this study, the same patient's group are non-diabetic with a total of 48 CKD-5 dialyzed patient data collected three times over 30 days. Subsequently, in both condition (fasting and postprandial), dialysate sugars also

showed statistically substantial changes as blood sugar levels decreased. No patients have been diagnosed with hyperglycemia. Paired t-test calculation of the mean difference between fasting and postprandial glucose levels is 26.68 SD difference is 11.44, p value is < 0.001 , so a significant difference is $P < 0.05$. It is possible that mid-dialysis snack should be given to patients undergoing dialysis to prevent hypoglycemia and its complications.

Keywords: *hemodialysis, chronic renal disease, hypoglycemia.*

NEW ONSET OF HEALTH COMPLICATIONS IN PATIENT AFTER COVID-19 RECOVERY

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Global pandemic coronavirus caused by COVID 19 appears to cause significant morbidity and mortality worldwide. Until now, acute respiratory problems, particularly in critically ill patients, have been the primary concern of clinical communication. Several case studies and limited series have indicated that COVID-19 significantly affects the respiratory and cardiovascular processes. Older individuals are at increased risk of serious illness due to COVID-19, and frequency increases with age. Many with ongoing medical conditions can also have a greater risk of severe illness. Various organs that may induce infection are the lungs, skin, kidneys, liver, heart and GI tract. Thus, the risk of severe illness due to COVID-19 rises in patients with comorbidities linked to these organs. Patients healed after COVID-19 should now be more vigilant in their daily health check-up and surveillance. The present analysis showed a health complication following the recovery of COVID-19 that was required to avoid chronic disease, which would again cause mortality and morbidity in patients.

Keywords: *COVID-19recovered, secondary illness, health problems of COVID-19.*

PERCEPTION ON EXTENT OF AWARENESS AND EFFECT OF COVID-19 TO THE RURAL PEOPLE

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COVID-19 is an infectious disease which caused severe pandemic worldwide. Due to its affect of various agricultural sectors such as crop, livestock and fishery have been smash hard by pandemic. The study was conducted perception on extent of awareness and effect of Covid-19 to the rural people in Cooch Behar district of West Bengal. 80 no. of respondents from 4 villages who experienced the negative impact of lockdown due to Covid-19 are selected for the study. The data were collected through well structured interview schedule with online Google form as well as verbal communication in mobile phone. Collected data were compiled and analyzed with simple statistical tools to draw a specific conclusion. The results showed that 41.25 per cent of the respondent had high level of awareness on COVID-19 followed by 20.0 per cent had lower level of awareness on corona virus disease. The finding also said that 82.50 per cent of the respondent had faced challenges of lack of opportunities for earning money followed by 72.50 per cent of scarcity

of food materials or insufficient food items in the locality during the pandemic of COVID-19. Due to lockdown, the movement of agriculture produces from its place of production to the ultimate consumer has been affected. It is suggested that some more specific and need based income generating measure is required to be taken by the various existing government and non-government organization to reduce the pandemic situation among rural community of the villages.

Key words: COVID-19, awareness, effect, rural people

HYDROPONICS: AN ADVANCED TECHNIQUE

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The challenges to agriculture in the next few decades are to achieve maximum production of food without further irreversible depletion or destruction of our natural resources. The purpose of agriculture has always been to produce enough food to feed the entire population. This will require a doubling of present crop production capacities in the next fifty years which though difficult is not impossible. However, there is an urgent need to adopt ecofriendly technologies and conserve fast depleting land and water resources. In this context, hydroponics technology can be an efficient technology for food production in extreme environmental ecosystems such as deserts, mountainous regions, or arctic communities. The term Hydroponics was derived from the Greek words i.e. *hydro* which means water and *ponos* means labour and literally means water work. The word hydroponics was coined by Professor William Gericke in the early 1930s; describe the growing of plants with their roots suspended in water containing mineral nutrients. Various terms have been used to describe the technique for growing plants in some medium other than soil including hydroponics as soilless culture, tank farming and nutriculture. Hydroponics is a technique of growing plants without soil. Instead of having their roots nourished and supported by soil, the plants are supported by an inert growing medium like cocopeat and are fed via a nutrient-rich water solution and uses about 70% less water than normal farming.

STUDIES ON GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN TABLE PEA (*Pisum sativum* var. *Hotense* L.)

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An experiment was conducted to estimate genetic variability, heritability and genetic advance of eight parents and 28 f_1 's of table pea during 2018-19 and 2019-20 at HRC, SVP UA&T, Meerut (UP) 250110. The observations were recorded on various yield and yield contributing characters. Analysis of variance showed the significant variability for all the studied characters. High heritability was recorded for all characters except width of pod (55.84 %) which was medium heritability. High GCV and PCV were recorded in seed yield per plant and number of pods per plant which indicates the presence of high genetic variation. High heritability coupled with high genetic

advance observed for the traits viz. plant height, seed yield per plant, number of pods per plant, length of first fruiting node, days to 50% flowering, number of first fruiting node, length of pod and number of seeds per pod which indicates presence of additive gene action and demands for population improvement by selection. The genotypes with specific characters can be utilized for hybridization programme.

CHARACTER ASSOCIATION AND PATH ANALYSIS IN TABLE PEA (*Pisum sativum* var. *Hortense* L.)

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An experiment was conducted to estimate correlation coefficients and path coefficient analysis in Table pea using 36 genotypes including parents and F₁'s on nine quantitative characters. Correlation coefficients revealed that seed yield per plant showed highly significant and positive correlation with number of pods per plant (0.821, 0.818), length of first fruiting node (0.587, 0.585), number of seeds per pod (0.547, 0.517), days to 50% flowering (0.467, 0.464), plant height (0.447, 0.447), width of pod (0.387, 0.284), length of pod (0.375, 0.363) and number of first fruiting node (0.353, 0.349). Path coefficient revealed, highest positive direct effect on seed yield per plant was exhibited by number of pods per plant, number of seeds per pod and days to 50% flowering at both genotypic and phenotypic level.

STUDY ON EFFECT OF DIFFERENT LEVELS OF NITROGEN APPLICATION UNDER DIFFERENT IRRIGATION REGIMES ON THE GROWTH AND YIELD OF POTATO (*Solanum tuberosum* var. *Kufrisindhuri*)

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A field experiments was conducted during 2017-2018 and 2018-2019 to investigate the effects of different levels of nitrogen under different irrigation regimes on the growth and yield of potato (*Solanum tuberosum*). The experiment consisted of three treatments for nitrogen levels: N₁(120 kg ha⁻¹), N₂(100 kg ha⁻¹) and N₃(80 kg ha⁻¹) and three treatments of irrigation regime: I₁(100% of full irrigation), I₂(80% of full irrigation) and I₃(60% of full irrigation). Results indicate that both irrigation regime and nitrogen levels influenced potato plant height, leaf area index, dry matter accumulation, number of tubers per plant, weight of tubers per plant and tuber yield. Recorded values of growth parameters (plant height, leaf area index, dry matter accumulation) increased as irrigation and nitrogen levels increased. Yield parameters (number of tubers per plant, weight of tubers per plant and tuber yield) were also found to increase as irrigation and nitrogen levels

increased. Treatment I₁ resulted in a higher economic return for both the years. Similarly, highest water use efficiency was recorded for treatment N₁ during both the years of field observation.

Keywords: *Potato, Dry matter accumulation, Drip Irrigation, Tuber yield*

MANAGEMENT OPTION FOR INVASIVE PEST: FALL ARMYWORM (*Spodoptera frugiperda*) AND TOMATO PINWORM (*Tuta absoluta*)

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The globalization has increased international agricultural trade, and movement of seeds and planting materials has enhanced the risk of introduction of alien pests into India. These species, if not accompanied by the natural enemies which keep them in check in their native range, can multiply in large proportion and cause damage to economically important plant species and crop plants. Instances such as Fall armyworm *Spodoptera frugiperda* (J.E. Smith) and Tomato pinworm *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) were recent examples. *Tuta absoluta*, is an oligophagous pest infesting many solanaceous crops. Since the 1960s, this moth has become one of the key pests of tomato in South America. In Europe, *T. absoluta* presence was initially reported in the Eastern Spain in the late 2006, thereafter, it was recorded in many parts of Europe, Northern Africa and sub-Saharan countries. In India, *T. absoluta* was first reported near Bangalore, Karnataka state in 2014. Explosive spread and dissemination of *T. absoluta* is mainly correlated with multiple factors like lack of awareness among the farming community about the pest and their management practices, Tomato price reduction, conducive climatic factors etc. Which further led to outbreak situations in south and central India. The tomato *T. absoluta* can cause crop losses up to 100% and it is considered a key pest of greenhouse and open-field tomato. The pest is multivoltine having nearly 12 generations per year. The rapid growth, potential natural dispersal and resistance to insecticides render this pest as the most serious threat for tomato production systems worldwide. Spinetoram, a mixture of spinetoram J and spinetoram L toxin, is a new kind of fermentation-derived from soil actinomycete, *Saccharopolyspora spinose*. These compounds exert their selective activity against insects primarily by allosterically activating nicotinic acetylcholine receptors (nAChRs), binding at receptor sites distinct from those at which other insecticides exert their activity. It has a broad range of action against many insect pests, especially lepidopteran, Leaf miner and Thrips. Testing in agriculture systems demonstrated that spinetoram maintained the exceptional environmental and toxicological profile already established for the spinosyn class of chemistry. Spinetoram received the United States Presidential Green Chemistry award for 2008 (Environmental Protection Agency). Field studies were conducted to understand the spinetoramTM performance on *Tuta absoluta* and trial results were concluded that SpinetoramTM 120SC @ 54g ai/ha in 375lit of water can be used for management of *Tuta absoluta* and also it can be a potential component in Integrated Pest Management. Fall armyworm (FAW), *Spodoptera frugiperda*, has been a pest for over 200 years in the Americas, where the preference and damage to corn has been severe. FAW was first discovered in Asia on corn in Karnataka, India in 2018 and is now present in most corn production regions. With the ability to cause complete yield loss, FAW presents a threat to farmers and food security in Asia. Corteva AgriscienceTM offers integrated solutions to mitigate the threat of FAW. Integrated solution begins with a seed applied technology, Lumivia® (containing IRAC Group 28 chlorantraniliprole) that moves systematically into the plant and controls multiple lepidopteran pests, including FAW. Lumivia® enables an early and healthy stand establishment in corn. Lumivia® is registered for protection against seedling infestations of FAW in the United States and

Brazil. Infestations of FAW that occur after stand establishment can be managed with applications of spinetoram, a member of the spinosyn class of insecticides (IRAC MoA Group 5). Spinetoram provides effective control of fall armyworm at a rate of 30 gai/ha and controls insects by ingestion and through contact, providing quick knockdown and residual activity. When used in an integrated approach, Lumivia seed applied technology and spinetoram insecticide, provide for a complementary and superior performing approach for the management of fall armyworm.

DESERT LOCUST *Schistocercagregaria*: STATUS, IMPACT ON FOOD SECURITY AND MANAGEMENT STRATEGY

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Desert Locust (*Scistocercagregaria*) is a unpredictable devastating pest, connections between locusts and people date back millennia and remain a major food security challenge throughout the world today. The impressive capacity of locust swarms to rapidly move long distances and descend on communities unexpectedly has shrouded their source in mystery. predictability and overwhelming nature of these outbreaks has also likely contributed to the perception that, outside of active treatment of outbreaks, people are passive recipients of swarms. For instance the desert locust, *Schistocercagregaria*, can potentially affects 60 countries and a single swarm can cover 1,200 km². Swarms of locusts have invaded vast swathes of land in India since April 11th this year. They entered several districts of Rajasthan via Pakistan's Sindh province. Few days later, they entered the neighboring State of Madhya Pradesh. Many districts in Uttar Pradesh have been put on alert. This locust attack has affected about 90,000 hectares across 20 districts in Rajasthan. Favorable rain-bearing winds aided their transport towards India. This quickly growing swarm is now threatening to amplify into an agrarian disaster. Successful management of locust upsurges requires the infrastructure both for robust monitoring throughout a locust's range to aid in early detection and for rapid and targeted treatment of nymphal bands. Effective management strategies thus often require international cooperation and a strong consideration of scale. A huge challenge is likely to emerge when they start breeding. Last year, mature locusts had entered parts of India after a gap of 26 years. According to the Food and Agriculture Organization, the destructive power of a typical locust swarm can be enormous. The size of these swarms can vary - from less than one square kilometer to several hundred square kilometers. Most countries combating locust swarms are mainly relying on organophosphate chemicals. These are applied in small concentrated doses by vehicle-mounted and aerial sprayers. Drones have been deployed for controlling locusts in Rajasthan. A drone can spray pesticide on nearly 2.5-acres during a flight of 15 minutes. In Uttar Pradesh, local villagers have been asked to make noise by beating 'thalis' and bursting crackers. Officials say these measures will help in controlling or eliminating locusts at their resting place. A one square kilometre swarm contains about 40 million locusts. They can eat as much food as 35,000 people assuming that each individual consumes 2.3kg of food per day. The U.N. Food and Agriculture Organization, however, has warned of more such attacks along both sides of the India-Pakistan border. But for a country which is already battling a pandemic, this is yet another challenge

EFFECT OF PLANTING DENSITY AND NUTRIENT MANAGEMENT PRACTICES ON THE PERFORMANCE OF MAIZE HYBRIDS DURING KHARIF SEASON

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Field experiments were carried out to study the effect of planting density and nutrient management practices on the performance of maize hybrids in acidic soils of Odisha at the Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha under the aegis of AICRP on Maize in the coastal ecosystem in *kharif* season during 2014, 2015 and 2016. The experiment was laid out in a split-split plot design with three replications. Two hybrids (Hishel and P3441) were allotted to the main-plots, two planting density (high-60 cm x 20 cm, normal-50 cm x 20 cm) to the sub-plots and three nutrient management practices i.e., SSNM (140:41:77 N:P₂O₅:K₂O kg/ha) based on target yield (65.0 q/ha), STCR (143:15:78) N:P₂O₅:K₂O kg/ha through fertilizer prescription equation target yield (65.0 q/ha) and RDF (120:60:60 kg N-P-K/ha) to the sub-sub-plots. The soil was sandy loam with 4.7 pH and low in available N, high in available P and medium in available K. The two hybrids were grown under rainfed condition with two planting density and three nutrient management practices. The Hybrid P3441 influenced higher growth parameters, more plant population (86.7 thousand /ha), produced maximum cob yield (7122 kg/ha-11.1%) and grain yield (6202 kg/ha-7.9%) and stover yield (17791 kg/ha-14.4%) to Hishel (6413 kg/ha, 5739 kg/ha, 15550 kg/ha), respectively. Similarly, the high plant geometry (50 cm x 20 cm) significantly yielded highest cob yield (7497 kg/ha-18.5%), grain yield (6122 kg/ha-7.7%) and stover yield (17783 kg/ha-14.3%) as compared to normal plant geometry (60 cm x 20 cm) i.e. 6327 kg/ha, 5684 kg/ha and 15557 kg/ha, respectively. Likewise, among the three nutrient management practices, Soil Test Crop Response (STCR) significantly resulted in highest cob yield (7564 kg/ha), grain yield (6328 kg/ha) and stover yield (17786 kg/ha) over RDF (6219 kg/ha, 5310 kg/ha and 14792 kg/ha), but it remained at par with SSNM 7237 kg cob /ha, 6074 kg grain /ha and 17228 kg stover /ha. The increase in cob yield, grain yield and stover yield of STCR was 21.6 %, 19.2 %, 20.2% higher over RDF and 16.3 %, 14.4 %, 16.5 % to SSNM.

Keywords: Maize, STCR, SSNM, RDF, Cob yield.

EXPLORING COMBINATIONS OF ROOTSTOCK PLANTING TIME, SCION TYPE AND TIME OF GRAFTING ON GRAFTING SUCCESS OF WALNUT PLANTS

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The present study entitled “Exploring combinations of rootstock planting time, scion type and time of grafting on grafting success of walnut plants ” was carried out in the Experimental Farm, of Division of Fruit Science, SKUAST-K- Shalimar during the years 2017 and 2018. The experiment was laid out in a Randomized Complete Block Design with three replications having 15 plants per replication. In this study rootstock were planted at three different timings (2nd fortnight of November, 2nd fortnight of December, 2017 and 2nd fortnight of January, 2018) and were grafted with two different scion types (Middle portion of current season growth with 3-5 buds and Current

season growth (3-5buds) with small piece of 2- year old-wood) on two different dates (3rd week of February and 1st week of March, 2018) under polyhouse conditions. The results obtained indicated that initial graft success (75.28%), leaf area (350.02cm²), leaf number (11.34), scion girth (4.78cm), shoot length (21.77cm), final plant height (132.98cm) and final graft success (69.05%) were significantly better when rootstocks were planted during 2nd fortnight of November as compared to other timings of rootstock planting. Among two different scions viz., (Middle portion of current season growth with 3-5buds) and (Current season growth (3-5buds) with small piece of 2-year old wood), initial graft success (63.66%), leaf area (309.95 cm²), leaf number (12.89), scion girth (4.31cm) and shoot length (19.33cm), final plant height (119.78cm) and final graft success (58.00%) were observed better with scion type having middle portion of current season growth with 3-5 buds. Time of grafting significantly influenced all the recorded parameters and best results were obtained when grafting was performed during 3rd week of February as compared to 1st week of March.

Keywords: Rootstock planting, scion type, grafting, walnut, sulaiman.

PROTECTIVE CLOTHING FOR SANITIZATION WORKERS

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Corona virus Disease 2019 (COVID -19) is an acute respiratory disease caused by a novel Corona virus (SARS-CoV-2), transmitted in most instances through respiratory droplets, direct contact with cases and also through contaminated surfaces/objects. Though the virus survives on environmental surfaces for varied period of time, it gets easily inactivated by chemical disinfectants such as sodium hypochlorite or phenolic disinfectants which reduce the risk. The sanitization process is carried out by the sanitization workers at public places (where chances of getting infection are high) so; protective clothing is an important line of defence for workers in this occupation. It is best possible way to avoid direct contact with chemicals as well as it also reduces the risk of infection in the workers. Therefore, use of protective clothing is an effective tool which provides dual protection to the sanitization workers.

Keywords: Protective clothing, Sanitization workers, Corona virus and infection

COMPARATIVE STUDY ON YARN COUNT OF COTTON AND NETTLE/COTTON BLEND PRODUCED FROM OPEN END SPINNING BEENU SINGH AND MANISHA GAHLOT

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Yarn characteristics extensively influence by spinning process. Open end spinning was used for yarn development. The open end spinning system is used for unconventional fibres that have structural problems and may result in coarse to medium counts. The aim of this study is to observe the effect of open end spinning process on yarn count of 100 % cotton yarn and 50:50 nettle: cotton blended yarn. The twist per inch of 11 to 10 was set to fabricate 12.14 Ne and 9.50 Ne count of yarn respectively. The effect of spinning process on the yarn count was evaluated by Fisher's least significant difference (LSD). The results exposed that yarn count of open end spinning were exhibited higher for the unconventional fibre blended yarn.

Keywords: Open End Spinning System, Unconventional Fibres, 100 % Cotton Yarn, 50:50 Nettle: Cotton Yarn

COVID 19: MEDICINAL HERBS CAN STRENGTHEN OUR IMMUNE SYSTEM

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Medicinal herbs can help the people to boost their immunity system during this outbreak of Covid 19. Plants are rich in alkaloid, flavonoids, terpenoids, glycosides, lactones vitamin C, or the carotenoids hence can increase immune function. According to the Unani and Ayurvedic systems as practised in India, medicinal herbs extract has antimicrobial activity against many genera of bacteria, fungi and viruses and also helps to boost immune system. Therefore, this paper is reviewed to inspire the researchers about the medicinal values of some herbs that fight against viral infection and helps to increase immune power. Medicinal herbs may be helpful for boosting the immune system and preventing colds and the flu. The immune system maintains homeostasis by defending against viruses and bacteria which can cause inflammation in the body, illness and disease. For nutritional deficiencies can impair immune function, increases both the risk and severity of the infection. So it is needless to say that there is a correlation between medicinal plants, immune system, antiviral properties and Covid19. Effort has been made to shortlist the medicinal herbs which is found in West Bengal possess antiviral properties and boost immunity system due to presence of alkaloids, glycosides, terpenes, steroids, flavonoids, tannins, saponins, vitamin C. This discussion will give a brief idea about the some herbs, which have antiviral properties and can be used in it inhibits the growth of the virus, boosts immunity and fights the foreign pathogens

Keywords: Medicinal Herbs, Immune System, Traditional Uses, Vitamine C

IMPACTS OF CLIMATE CHANGE ON KHARIF RICE PRODUCTION IN ODISHA

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Crop growth is highly sensitive to any changes of climatic conditions and the variability in climate also affects the crop production. Temperature rainfall and solar radiation are three important parameters related to climate change, which affects the crop yield of any region. In Odisha rice is a predominant crop of the *Kharif* season and its cultivation is highly dependent on rainfall. In the present study an attempt has been made to access the impact of these weather parameters on the productivity of a rulling rice variety Swarna in warm and humid region of Odisha using CERES-Rice model of Decision Support System for Agro technology Transfer (DSSAT) 4.6 version. The climate change projection has been estimated using four global climate change Representative

Concentration Pathway (RCP) scenarios 2.6, 4.5, 6.0 and 8.5 for four future years 2030, 2050, 2070 and 2090 by using MarkSim GCM -DSSAT weather file generator. Under the projected climatic condition for the years 2030, 2050, 2070 and 2090, RCP 4.5, 6.0 and 8.5 scenarios, increasing trend is observed in seasonal maximum temperature, minimum temperature and decreasing trend in rainfall, found to cause major negative impacts on the grain yield of rice in *Kharif* season. A field experiment was conducted at Agrometeorology Field Unit to verify the growth, development and yield of four rice cultivars transplanted under four different dates of planting. The treatments were laid out in split plot design with dates of transplanting in main plots and varieties in sub plots in three replications. Tagged hill data, Leaf Area data were taken in fifteen days interval up to maturity. In this study growth, development and yield of rice *cv.* Swarna is verified under four different dates of planting. In *cv.* Swarna the increasing effect of seasonal temperature up to 1⁰C combining with increase in solar radiation and decrease in rainfall as per RCP scenarios causes increase in yield of *kharif* rice under RCP 2.6 scenario however, grain yield decreases with increase in temperature of more than 1⁰C along with solar radiation more than 2.5 MJ/day. The projected impact under RCP 4.5, RCP 6.0 and RCP 8.5 scenarios is much severe as compared to RCP 2.6 scenario on the grain yield characteristic of rice resulting in drastic decrease of the yield in future for the years 2030, 2050, 2070 and 2090. The maximum decrease of grain yield is expected to be up to 35% in 2030, 57% in 2050, 56% in 2070 and 59% in 2090 under all the RCPs except RCP 2.6, in all the four dates of planting, resulted in thinking of medium and short duration variety instead of long duration variety.

Keywords: Rice, Swarna, RCPs, Kharif, Climate.

SELF-HELP GROUPS AS A TOOL FOR WOMEN EMPOWERMENT

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Women are an integral part of society. All-round development and harmonious growth of a nation would be possible only when women are given their desired place and position in the society and are treated as equal partners of progress with men. However, in most of the regions, women have a low social and economic status. In such areas, effective empowerment of women is essential to harness the women in the main stream of economic development. Empowerment of women in general and poor women in particular is the thrust area of development initiatives in India today. Empowerment is a process of awareness and capacity building leading to greater participation to greater decision-making power and control and to transformative action.

In India more attractive schemes have been introduced, to eradicate women unemployment, one of which with less effort is Self Help Group (SHG). Self Help Group is one of the most important approaches for women empowerment in India. It is a group of rural poor females who have volunteered to organize themselves into a group for eradication of poverty of the members. SHG addresses various dimensions of empowerment – political, material, cognitive, perceptual and relational. SHGs are increasingly about empowerment of individual woman as well as of the groups themselves. SHGs of all types have an important role in development. The implementation of SHG has generated Self-employment opportunities for the rural poor. Many governmental and non-governmental organizations have been trying to organize women into groups integrate them into the development process by actively involving them in transfer of technology, production and

marketing, planning, implementing and monitoring of different projects on rural development, agriculture and allied sector development, natural resource management, etc. This has been shown by many SHGs formed by JEEVIKA in Bihar. Group Farming by Self-help groups (SHGs) have been mainly organised for supporting micro enterprises operated by women with the help of micro-credit with the growing diminution in the size of operational holdings.

SHGs will however become sustainable, only if they have backward linkages with technology, credit and forward linkages with processing and marketing organization, Steps will have to be taken to convert micro-finance into livelihood finance through appropriate support system. There is also need for establishing SHG Capacity Building and Mentoring Centers. Further, scaling up of bank linkages and increased SHG activities would require a large force of trainers. Besides, there has to be common training approach, common book keeping approach, and common rating system. It will be useful to promote SGGs at the production end of the farming enterprise involving men.

THE ROLE OF LACTIC ACID BACTERIA IN MILK FERMENTATION

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Probiotics are products aimed at delivering living, potentially beneficial, bacterial cells to the gut ecosystem of humans. In future probiotics possibly will be used for different gastrointestinal diseases or as delivery system for vaccines. The term probiotic describes a variety of microorganisms can be introduced in the diet of adults and children both. Regular use could improve the quality of life and reduce the dependence on drugs and medical expenses.

Keywords: Lactic Acid Bacteria; Milk Fermentation and Health.

CONSTRAINTS AND CHALLENGES FACED BY THE RURAL WOMEN IN AGRICULTURAL ACTIVITIES IN A RICE BASED FARMING SYSTEM - A STUDY IN PURI DISTRICT OF ODISHA, INDIA

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Rural women in Odisha play a significant role in agriculture and allied activities. They are actively participating in all range of agricultural activities including pre-harvesting, and post-harvesting. But despite such a huge contribution, her role has yet not been recognized and they are considered as 'invisible farmers'. The current research was carried out in Puri district of Odisha state. For the present study a total of 120 rural women were selected from 4 villages of Puri district through multistage random sampling technique. Keeping in view these facts the present study has been designed to explore the Constraints and challenges faced by the rural women in agricultural activities. Cultural norms in our society are male dominated and women are not allowed to go freely for participating in agricultural extension services activities and these constraints faced by rural women must be eliminated for full growth and development. Mainly they are facing no exposure

visit for experience and there are no special training programmes to develop women's agricultural practices and technological skill. Eco-friendly and drudgery reducing technology is rarely available. Maximum number of women in study area facing no subsidy facility from Government, high rate of interest and no flexibility in mortgage. Main constraints were Extension personnel's didn't diagnose the problem timely and there are no storage facilities and difficulties in marketing at distant place.

Keywords: Constraints and Challenges, Rural Women, Agriculture

LINKAGE DISEQUILIBRIUM ANALYSIS STUDY REVEALS THE GENETIC ARCHITECTURE OF FLOWERING TIME AND YIELD IN INDIAN MUSTARD (*Brassica juncea* L.)

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Flowering Plants are evolved to have sophisticated systems to acclimatize to local conditions, domestication and natural or artificial selection. The selective pressures of these different growing conditions have caused significant genomic divergence within species. This crucial factor plays major role to maintain the sustainable development. Triggering the flowering at appropriate times can also prevent plants from suffering from adverse growth conditions, such as disease escape, drought, and winter hardness. Hence, discovering the genome-wide genetic mechanisms that influence flowering time variations and understanding their contributions to adaptation at this vital phenological stage is important topic of interest. In present study a core collection with 64 *Brassica juncea* lines was first planted in two year trials independent environments, and their flowering time traits were Phenotyped. A genome-wide association mapping of flowering times with 82 SSRs for core set was done. In total, showed marker-trait associations two year trial. On the whole 26 QTLs were identified but only 1 QTL showed significant association with flowering time variations and it was based on a *p*-value of 7.27E-07. To explore flowering time QTLs and genes related to growth habits in Indian mustard, selection signals related to divergent habits were screened at the genome-wide level Based on this study, a number of marker-trait associations and candidate genes for flowering time variations in Indian mustard were revealed. These results will be applied to Brassica breeding programs to assist in selection of best lines for their use in molecular breeding.

Keywords: Growth habits, flowering time, GWAS, *Brassica juncea*

PRODUCTIVITY AND ECONOMIC FEASIBILITY OF RICE UNDER DIFFERENT PLANTING METHODS IN TBP AREA

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ICAR- Krishi Vigyan Kendra, Gangavathi conducted 10 frontline demonstrations of Direct seeded rice during 2018–19. The critical inputs were identified in existing production technology through meetings and discussions with farmers. Prevailing farmers' practice of transplanting method were treated as control for comparison with DSR practices. The average yield registered 11.24 percent higher over the farmers practice. The highest grain yield (8.63 t/ha) was recorded in the year 2018-19, it was 11.24 per cent more over the farmers practice (7.76 t/ha). Average net profitability of

worth Rs. 121460.00/ha as compared with farmers practices (Rs. 94763.00/ha) were obtained and average benefit cost ratio i.e. 3.29 and 2.53 were recorded in demonstrated plot and farmers practice respectively. The higher additional returns and effective gain obtained under demonstrations could be due to reduced incidence of pest and diseases, reduced cost of cultivation due to less labour and input requirement and saves the irrigation water up to 30 to 40% and increase in yield up to 8 to 12% compared to transplanting method.

Keywords: DSR, Transplanted, Rice, Yield gap, Economics

EVALUATION OF CERTAIN BOTANICALS AS SEED PROTECTANTS AGAINST PULSE BEETLE, *CALLOSBRUCHUS CHINENSIS* (L.) ON CHICKPEA

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A laboratory experiment with six different botanicals as seed protectants against *Callosobruchus chinensis* on chickpea (*Cicer arietinum*) was carried out at $27 \pm 2^\circ\text{C}$ and 70 % RH. The study involves the use of Neem leaf powder 5g/ 100 seeds, Nimbicidin 5ml/ 100 seeds, Karanji oil 5ml/ 100 seeds, Custard apple leaf powder 5g/ 100 seeds, Castor oil 5ml/ 100 seeds and Eucalyptus oil 5ml/ 100 seeds against *C. chinensis* in chick pea. The observations recorded on percent seed infestation, percent seed weight loss, percent fecundity and percent oviposition, where Deltamethrin (2.8 EC) 0.04ml/ 100 seeds and untreated treatment used as standard check and untreated check respectively. The results revealed that all the treatments was significantly superior then the untreated control thathave maximum insect damage (9.0%) at 30 days of storage period. Insectinfestation percent was increased in all the treatments with period increased instorage and nature of protectants. Minimum percent infestation and percent weight loss were noted in Deltamethrin (2.8 EC) 0.04ml/ 100 seeds followed by Nimbicidin 5ml/ 100 seeds and highest were in untreated control. The present study concluded that application of bio inputs were effective next to insecticides for the management of pulse beetle in chickpea.

Key words: *Callosobruchus chinensis*, botanicals, Seed infestation, fecundity, mortality

ORGANIC PESTMANAGEMENTIN RICE: AN ECONOMICAL PRACTICE

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The yellow stem borer, *Scirophaga incertulas*, is an important pest of rice for entire South Asia. Stem borer is most commonly experienced in tropical lowland rice and deep-water rice. The overall annual loss due to stem borer in rice in India, China and South East Asia ranges between 5-10% but an individual farmer may lose upto 50-60% of production. Recovery or prevention of 5% of the losses to stem borers could feed approximately 140 million people for 1 year. Organic pest management in rice can help reduce production cost to significant degree. Organic pest management practices are more economical, sustainable and can be carried with locally available

resources. Biological control of pests in rice using bacterial and fungal biocontrol agents can be made more pest specific. Maintaining of natural enemies in rice field provides resilience in rice ecosystem and is an effective way of controlling pest population in rice field. Application of trap plants like vetiver grass are effective in reducing pest population by preventing pest to complete life cycle. Adjusting application of nitrogenous fertilizer is crucial since many pest outbreaks are associated with excessive application of nitrogenous fertilizers. Depending upon the agroclimatic situation scientific farming practices like adjusting sowing dates, using pheromones, biopesticides and traps are also effective natural management practices. It is therefore more complex than certain traditional pest control practices such as the use of chemical pesticides. With the existing technologies and practices, it might not be possible to transform rice production completely organic but use of agrochemicals can be made limited to small fraction using Integrated Pest Management practices in rice.

Keywords: Biological control, Natural enemies, IPM

EFFECT OF NUTRIENT MANAGEMENT OF ACID LIME (*Citrus aurantifolia* Swingle) cv. Balaji UNDER SUB-HIMALAYAN TERAI REGION OF WEST BENGAL.

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Citrus is one of the largest and most important groups of fruit crops in tropical and subtropical regions. The genus *Citrus* consists of several species of commercial importance like mandarins, oranges, limes, lemons, pumello and grape fruits. There are four commercially important species of lime namely, *Citrus aurantifolia* (Acid lime), *C. latifolia* (Tahiti lime), *C. limonia* (Rangpur lime) and *C. limettoides* (Sweet lime). Acid lime (*Citrus aurantifolia* Swingle) is considered as most important fruit crop. Acid lime is also known as Kagzi lime or Neebu. It is considered to be native of Malayan peninsula. It belongs to the family Rutaceae, with chromosome number ($2n=18$). The nutrient elements, especially micronutrients when applied as foliar spray exerted pronounced influence on plant growth and yield (Ibrahim *et al* 2009). Keeping the foregoing points in consideration, an experiment conducted at the farmer's field at Gopalpur, Cooch Behar during June, 2018 to June 2020. Effect of nutrient management of acid lime (*Citrus aurantifolia* Swingle) cv. Balaji has applied nutrients (Soil and foliar application) with 20 treatment combinations, using 2 factor RBD design. In this experiment used different nutrient sources of NPK *i.e.*, FYM 25kg, vermicopost 20kg + Azotobactor 25g, 900:400:400 g NPK (100% NPK) as soil application and micronutrients $ZnSO_4$ 0.5% + Borax 0.4% + $CuSO_4$ 0.5% were applied as foliar spray to the plants while the control plants received no fertilizer, no foliar spray. It was concluded that the treatment T₁₅ [20kg vermicompost + 25 g Azotobacter (as soli application N₂) + $ZnSO_4$ 0.5% + Borax 0.4% + $CuSO_4$ 0.5% (as foliar spray F₄)] in acid lime were vital for increased morphological, reproductive, physical, chemical and yield characters and decreased number of seed/fruit, seed weight. 20kg vermicompost + 25 g Azotobacter (as soil application) + $ZnSO_4$ 0.5% + Borax 0.4% + $CuSO_4$ 0.5% (as foliar spray) may be beneficial under the terai zone of West Bengal.

Keywords: Acid lime, Nutrient management, Soil and foliar application.

HI-TECH HORTICULTURE IN INDIA: CHALLENGES AND OPPORTUNITIES

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Hi-tech horticulture is now widely employed for the profitable commercial production of horticultural products. Hi-tech horticulture practices includes Integrated Pest Management (IPM), Integrated Nutrient Management (INM), Plasticulture, Greenhouse Cultivation or Protected Cultivation, Hydroponics, Microirrigation or Drip irrigation, Fertigation, Sub-surface Drainage System, Precision Farming, High Density Planting, Hi-Tech Mechanization, Molecular Diagnostics etc. In the recent era, horticulture is not merely a means of diversification but forms an integral part of food and nutritional security and is also an essential element of economic security. Hi-tech horticulture refers to the precise production techniques for efficient use of inputs at the appropriate time and quantity for maximization of yield and quality in different horticultural crops. It is an adoption of any technology which is modern, less environment-dependent, capital intensive and has the capacity to improve productivity and quality of horticultural crops. Hi-tech horticulture has also been a modern environment-friendly, acceptable, intensive technique to capacitate farmers for obtaining high productivity and quality products to fetch more money. It is a chain system of culturing fruits, flowers, vegetables and spices with a proper linkage from selection of seed/variety to the finished product through the process of modern technique of crop production through post-harvest management techniques. Protected cultivation of horticultural crops is the ultimate form of hi-tech horticulture in India for today and in most of the states in India protected cultivation of horticultural crops is common. Among the various protected structures, fully-automatic polyhouses help for cultivation even under unfavourable climatic conditions. The cost-effective structures such as net houses and low poly-tunnels are popular and are rapidly increasing in proportion. Although initial costs are high, ultimately the high value fetched by high-quality produce brings much higher income to the farmers. In frequent climatic aberrations these are useful for obtaining appropriate yields with better quality. Protected cultivation provides scope for less soil-dependent cultivation. The use of coco-peat and vermin-compost helps not only to increase yield but also to reduce soil-borne diseases. Presently the protected cultivation for horticultural crops in India is commercially practiced for plant propagation and commercial cultivation. Hi-tech horticulture is a powerful tool for doubling productivity of horticultural crops and can well be used for doubling farmers' income (DFI). Hi-tech horticulture is the need of all the developing countries and controlled-environment horticulture certainly has a promising future within multi-disciplinary plant-science research as well as many exciting applications within controlled-environment agriculture.

Keywords: Hi-tech, Horticulture, Opportunities, Challenges, Benefits

**A STUDY OF DEMOGRAPHIC PROFILE AND HEALTH PROBLEMS OF WOMEN FARMERS INVOLVED
IN ORGANIC FARMING**

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Women were perhaps the first to domesticate the crop plants, and have played a pivotal role in the development of agriculture. In today's world, comfort occupational health and safety issues have become very important and the same is true for agriculture also. . The present study had great practical utility for the women farmers who spend the whole day in their fields. Descriptive – cum – experimental research design was used for present investigation. The resent study has been carried out in Nainital district. Two block Haldwani and Bhimtal were selected for the present study purposively. The purposive – cum – convenience sampling design was sued to select the study area and women farmers. The total sample consisted of 120 women farmers. All the respondents were involved in organic farming. Majority of women farmers were suffering from back pain whereas few of them had respiratory problems. . The back pain emerged as major health problem. It probably was due to the fact tat women workers in bending posture for long hours in various activities

**NUTRIENT MANAGEMENT IN RICE USING PHOSPHATE SOLUBILIZING
RHIZOBACTERIA ISOLATES IN INCEPTISOLS**

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The present investigation was conducted during 2019-2020 in the Division of Soil Science and Agriculture Chemistry of Sher e Kashmir University of Agricultural Sciences and Technology, Jammu(J&K),to study nutrient management in rice rhizosphere using phosphate solubilising rhizobacteria isolates in inceptisols. Pot trial was laid out in a factorial CRD replicated thrice with six treatment combinations. Seven days old seedlings of rice variety Basmati 370 were applied with alone or in combination of TCP and PSRB isolates broth culture during the first week of July month. Significantly highest available N,P,K were recorded with treatment TCP(1g) + 10 ml combination of PSRB isolates broth culture at both tillering and panicle initiation stage of rice crop. Similarly highest plant nutrient uptake Total N (20.96 g/pot), P(11.16 g/pot), K(17.82g/pot) were recorded with same treatment. Application of TCP and combination of PSRB isolates broth culture recorded maximum soil microbial biomass carbon ($96.25\mu\text{g}^{-1}$ soil, $98.88\mu\text{g}^{-1}$ soil) at both tillering and panicle initiation stages of rice crop. Maximum dehydrogenase activity was recorded ($56.76\text{ mg TPF g}^{-1}\text{ hr}^{-1}$ soil, $57.79\text{ mgTPFg}^{-1}\text{hr}^{-1}\text{soil}$) with application of TCP and combination of PSRB isolates broth culture. Application of TCP along with combination of PSRB isolates broth culture was proved to be best among all treatments in terms of yield viz. 29.3 g/pot and yield attributes viz. no. of panicles⁻¹plant (13.67), no. of grains⁻¹panicle (64) and average panicle length (31.02cm). Thus rhizosphere mediated nutrient management in rice through PSRB isolates alongwith TCP could be an effective strategy for an eco friendly agriculture alongwith improved soil health. Further research on PSRB isolates gains an immediate attention for microbial mediated nutrition management.

Keywords: Rice, Rhizosphere, Crop growth stages, TCP, PSRB.

**COMPARISONS OF QUANTITY AND QUALITY OF LIPIDS FOR TWO STRAINS OF
CHLORELLA VULGARIS AND THEIR EVALUATION FOR BIODIESEL PRODUCTIONS
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Renewable energy sources are the focus of this century. Economically and environmental friendly production of such energies are the challenges that limit their usages. Microalgae is one of the most promising renewable feedstocks. The objective of this work was to study the growth, lipid production and lipid profile of two different strains of *Chlorella vulgaris* BNL54, FKN45 an isolates from Punjab and Kedarnath, India respectively, under optimized culture conditions. Under N limitation, biomass production of both isolates decreased by 5% and the amount of lipids increased by 11% in *C. vulgaris* BNL54 and 9% FKN45 over control cultures. In *C. vulgaris* BNL54 under continuous illumination biomass increased by 7% while lipid content increased by 10%. The optimized condition for *C. vulgaris* FKN51 was pH 8.4 where the biomass and lipid content increased by 5% and 8% respectively. The fatty acid profile of lipids of the organism under optimized conditions also changed. Under continuous illumination *C. vulgaris* BNL54 showed saturated fatty acid (SFA) content were 69%, monounsaturated fatty (MUFA) were 14% and polyunsaturated fatty acids (PUFA) were 16%; compared to control cultures with 42% SFA, 27% MUFA and 30% PUFA. While *C. vulgaris* FKN51 saturated fatty acid (SFA) content were 54%, monounsaturated fatty (MUFA) were 26% and polyunsaturated fatty acids (PUFA) were 20% compared to control cultures with 39.3% SFA, 33% MUFA and 27.7% PUFA in medium with pH 8.4. This indicated fatty acid profile of lipids of both strains under optimized conditions were better from biodiesel production point of view.

**PRIORITIZATION OF A HIMALAYAN WATERSHED BASED
ON MORPHOMETRIC AND LAND USE ANALYSIS USING REMOTE SENSING AND
GIS TECHNIQUES**

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Watershed prioritization has become increasingly important in the management of natural resources, especially in the management of watersheds. An effective decision support tool to provide appropriate weights for different topographical, morphological, climatological and management factors responsible for soil conservation measures is required to identify environmentally stressed areas for planning soil conservation measures. An attempt has been made in the present study to examine morphometric and land use land cover characteristics for the Western Nayar in the Garhwal Himalaya region of Uttarakhand. Parameters of linear, areal, and relief aspects were analyzed under the morphometric study of the watershed. The linear and shape morphometric parameters have been used for each sub-watershed and assigned rank on the basis of value/relationship with erodibility so as to arrive at a compound value for final ranking of the sub-watersheds. The sub-watersheds were categorized into very high, high, medium, and low based on their ranks derived by morphometric and land use/land cover analysis.

Keywords: Watershed, Prioritization, Morphometry, Land use land cover, Remote Sensing, GIS

WEED MANAGEMENT IN GROUNDNUT (ARACHIS HYPOGAEA L.)

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Groundnut (*Arachis hypogaea* L.) well known as the 'king' of all oilseeds, is considered as one of the supreme food as well as cash crop of India. It is very well accepted under the name *wonder nut* and *poor men's cashew nut*. The nut has innumerable dietary benefits. Groundnut is remarkably very susceptible to various weed infestations. The occurrence of weeds can be explained in terms of its significantly slow growth in the initial stages of growth period (upto 40 DAS), short plant height and underground pod bearing. The weed infestations interfere with pegging, pod development as well as harvesting of crop at different stages of growth in addition to competition for basic resources. The type of irrigation, cropping system and other environmental factors influence the infestation and intensity of weeds in significant terms. Chief groundnut weeds include grassy, narrow-leaf, broad-leaf weeds and sedges causing substantial yield losses (15-75%). Taking in consideration the manual and mechanical methods to control weeds, has numerous limitations being less effective, costly and time taking as well as need of repetition at frequent intervals. Chemical weed control is a better way to conventional methods. These are becoming an integral part of the modern crop production cultivation practices. Hence, here are discussed various physical, chemical and mechanical methods that effect the growth and dispersion of weeds. The most commonly adopted weed management practices for groundnut is use of pre-emergence application of selected herbicides (e.g. pendimethalin or fluchloralin) followed by one hand weeding. So, the use of herbicides in weed management is found effective to eliminate weed appearance at early stage of crop growth. Hence, a brief review is done on the nature/kind of weed dispersion in groundnut, kinds of competition observed in crops and weeds, effect on growth and yield and different weed management practices in groundnut.

Keywords: Weed Management, Groundnut, Herbicides.

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Keywords: Watershed, Prioritization, Morphometry, Land use land cover, Remote Sensing, GIS

EFFICACY OF FUNGICIDES AGAINST EARLY BLIGHT (ALTERNARIA SOLANI ELLIS AND MARTIN) JONES AND GROUT OF TOMATO UNDER FIELD CONDITIONS OF KASHMIR

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Field studies were conducted to evaluate the comparative efficacy of six systemic and four non-systemic fungicides against early blight of tomato caused by *Alternaria solani* (Ellis and Martin). The experiments conducted during Kharif 2014 to study effect of some promising fungicides found under in vitro studies as foliar sprays against early blight of tomato. Three foliar sprays at 15 days interval with Difenoconazole 25 EC was the most effective fungitoxicant reducing the disease incidence to 23.48 per cent from 61.23 per cent, unsprayed check. The other fungicides in order of their decreasing efficacies were Flusilazole 40 EC > Hexaconazole 5 EC > Mancozeb 75 WP. Propineb 70 WP proved least efficacious among the test fungitoxicants reducing the disease incidence to 43.70 per cent from 61.23 per cent, unsprayed check. Similarly Difenoconazole 25 EC again proved most effective fungitoxicant in case of disease intensity reducing the disease intensity to 16.39 as against 41.31 per cent observed in unsprayed check. The other fungicides in order of their decreasing efficacies were Mancozeb 75 WP > Flusilazole 40 EC > Hexaconazole 5 EC. Propineb 70 WP proved least efficacious among test fungi toxicants reducing the disease intensity to 24.11 per cent. Difenoconazole 25 EC gave the highest disease control of 61.67 and 60.32 per cent in case of disease incidence and disease intensity respectively while the least per cent disease control of 43.70 and 41.63 per cent respectively was given by Propineb 70 WP.

Keywords: *Alternaria solani*, fungitoxicants, disease incidence, disease intensity

DIALYSIS INDUCED HYPOGLYCEMIA IN NON-DIABETIC CHRONIC KIDNEY DISEASE PATIENTS

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The observational clinical study was undertaken in 50 patients reported by the dialysis center, competent and able to be evaluated, classified into two groups of fasting and postprandial CKD-5 patients. This longitudinal observational research was performed in 48 consecutive CKD patients (male and female) at MLB, Medical College, Jhansi, India, from March 2016 to November 2018. After a short night, 5 ml of venous blood samples were obtained in transparent tubes. After selection, the samples were allowed to clot for half an hour during which the samples were centrifuged, and the serum was examined in the automated biochemical analyzer Selectra Pro M at the ISO 2015:2000 accredited Pathology Laboratory in the Medical College. In this study, the same patient's group are non-diabetic with a total of 48 CKD-5 dialyzed patient data collected three times over 30 days. Subsequently, in both condition (fasting and postprandial), dialysate sugars also showed statistically substantial changes as blood sugar levels decreased. No patients have been diagnosed with hyperglycemia. Paired t-test calculation of the mean difference between fasting and postprandial glucose levels is 26.68 SD difference is 11.44, p value is < 0.001, so a significant difference is $P < 0.05$. It is possible that mid-dialysis snack should be given to patients undergoing dialysis to prevent hypoglycemia and its complications.

**POTENTIAL USE OF SEAWEEDS EXTRACT IN AGRICULTURE
AMIT KUMAR PANDEY AND ASHUTOSH SINGH**

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Seaweeds are the macroscopic marine algae used as a substitute of chemical fertilizers. Seaweeds extract are marketed as liquid fertilizers and biostimulants because they contain multiple growth regulators such as auxins, gibberellins, cytokinins and various macro and micro nutrients necessary for plant growth and development. It also helps in promoting the growth of microorganism, developing tolerance to environmental stress and increasing nutrient uptake from soil. In recent years the use of seaweed extract is gaining popularity due to their potential use in sustainable agriculture. At present seaweed extract are used in agricultural practices and are already commercialized such as seaweed liquids fertilizers are available as manure, foliar spray, soil conditioners and soil drench. The foliar spray induces faster growth and increased yield in cereals, vegetables and horticultural crops. Higher germination percentage and seedling vigour are reported with low concentration of seaweeds extract. It has been reported that application of seaweed extracts not only improved the growth of the crops but also helped in increasing the number of functional nodules. The presence of high level of organic matter aids in retaining moisture and minerals in upper soils that is available to roots. The application of seaweed extracts also significantly increased oil content, oil yield of oil seed crops. Spraying seaweed extracts recorded tuber yields, total soluble solids and protein content of the potato tubers. It also contains chelating compounds that can increased availability of some micro nutrients to plants. Micronutrients content, amylase percentage, hulling percentage and protein content in rice grain also increased with the application of seaweed extracts even at low concentration. Marine bio active substances extracted from seaweeds are currently used organic farming in order to avoid excessive application chemical fertilizers and improving the uptake through the roots or leaves.

Keywords: Seaweeds, Agriculture, Use, Sustainability

**NATURAL FARMING: A WAY FOR DOUBLING FARMERS INCOME.
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Natural farming is sustainable farming with a lot of advantages over conventional farming system. It is eco-friendly, eco-environmental and eco-healthy. Natural farming is popularised in Himachal Pradesh under SubashPalekar Natural farming (SPNF) programme and later on emerged in Zero Budget Natural Farming (ZBNF). IN ZBNF farmers prepare traditional inputs on their farm from household or farms inputs. Basically it is much cheaper than other fertilizers & manures and other plant protection measures. These inputs don't have adverse effect on human health, soil fertility and crop have low maximum residual level. Products of natural farming have high export potential in both national and international level. Moreover, it also promote intercropping which helps to increase nutritional security in rural households. Yield potential is same as conventional farming and many studies reported higher yield than conventional farming. Natural farming have great scope for farmers to reduce cost of production with same or more yields on per hectare, which ultimately give higher net returns of the farmers and have a viable option for farmer to double the farmers income.

Key Words: Natural farming, Zero Budget Natural Farming (ZBNF), Income and Returns.

PROTECTIVE CLOTHING FOR SANITIZATION WORKERS

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Corona virus Disease 2019 (COVID -19) is an acute respiratory disease caused by a novel Corona virus (SARS-CoV-2), transmitted in most instances through respiratory droplets, direct contact with cases and also through contaminated surfaces/objects. Though the virus survives on environmental surfaces for varied period of time, it gets easily inactivated by chemical disinfectants such as sodium hypochlorite or phenolic disinfectants which reduce the risk. The sanitization process is carried out by the sanitization workers at public places (where chances of getting infection are high) so; protective clothing is an important line of defence for workers in this occupation. It is best possible way to avoid direct contact with chemicals as well as it also reduces the risk of infection in the workers. Therefore, use of protective clothing is an effective tool which provides dual protection to the sanitization workers.

Key words: Protective clothing, Sanitization workers, Corona virus and infection

MANAGEMENT OF SOILS FOR RECLAIMING FROM THE SITUATION OF COVID -19 RAMPANT TO PROMOTE SUSTAINABILITY

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The COVID-19 pandemic has disrupted the global food supply chain and exacerbated the problem of food and nutritional insecurity. Soil can be used for the safe disposal of medical waste, but increased understanding is needed on the transfer of virus through pedosphere processes. Strengthening communication between soil scientists and policy makers and improving distance learning techniques are critical for the post-COVID restoration.

Here we outline soil strategies to strengthen local food production systems, enhance their resilience, and create a circular economy focused on soil restoration through carbon sequestration, on-farm cycling of nutrients, minimizing environmental pollution, and contamination of food. Smart web-based geospatial decision support systems (S-DSSs) for land use planning and management is a useful tool for sustainable development. Forensic soil science can also contribute to cold case investigations, both in providing intelligence and evidence in court and in ascertaining the provenance and safety of food products.

Keywords: COVID-19 pandemic, food security, soil management, soil carbon sequestration,

ECONOMIC VIABILITY AND CONSUMER ACCEPTABILITY OF THE SMALL MILLET-BASED PRODUCTS DEVELOPED BY SELF HELP GROUP

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Millets are nutritionally superior; the non-availability of refined and processed millets in ready-to-use form has limited their wider use and acceptability. Millets are, therefore, confined to traditional consumers and also to the people of lower economic strata. Hence, there is a need to develop suitable milling systems to obtain milled millet grains at household and small-scale industrial levels with a view to facilitate their easy availability in ready-to-use form and evaluate to economic

viability and consumer acceptability of the Small millet-based products developed by Self Help Group. In present investigation. The methodology involved quantitative as well as qualitative assessment conducted in two villages of seoni District , namely, *Saliwada* and *Gunguj* from Lkhanadoan block and the work was carried out during 2014-2015. The SHGs were trained in processing of millet and products are being marketed at Rs. 100 per kg. At this price, the benefit cost ratio of the product is 1:88 for millet based 'products'. The calculation of cost of production and income was made for 2400 kg final products in both the cases. Consumer acceptability of various kinds of finger millet and little millet based products conducted at Krishi Vigyan Kendra, Seoni . A five point hedonic scale (extremely disliked-1 to extremely liked-5) was used. Individuals were divided into two group (A) consist of 30 student age between 16 to 20 year and (B) 20 house women age in between 25 to 40 year and they were asked to comments on the product. The average score values of various sensory attributes viz, taste, flavour and overall acceptability of the different finished products made from finger millet and little millet were found to vary in the range of 4.0 to 4.7 and 4.2 to 4.6, respectively.

Key words: Millets, SHGs, Value addition, sensory evaluation , Economic Viability

CORRELATION ANALYSIS OF SOCIO-DEMOGRAPHIC PROFILE OF PADDY GROWERS WITH KNOWLEDGE AND ADOPTION LEVEL OF CLIMATE RESILIENT AGRICULTURAL TECHNOLOGIES

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Objective: To find out the relationship between knowledge and adoption of Climate Resilient Technologies with profile characteristics of Paddy growers.

Hypothesis: There is no association between the profile characteristics of paddy growers and their knowledge and adoption level on Climate Resilient Technologies.

Method: The present study was conducted during the year 2017-18 in the Mandya district of Karnataka state. Two villages each in Head reach and Tail end area of Krishna Raja Sagar (KRS) Dam were randomly selected. In each selected village twenty five paddy growers were randomly selected. Thus, 100 farmers constituted the sample for the study. The data was collected from the respondents using a structured interview schedule developed for the purpose. The data collected was analyzed and tabulated using appropriate statistical tools.

Result: The results revealed that, positive and significant relationship at one per cent level between the independent variables such as education, risk orientation, cosmopolitaness, scientific orientation, mass media exposure, extension participation, innovative proneness and extension contact with both knowledge and adoption level. Whereas independent variable economic motivation had positive and significant relationship with knowledge level at one per cent level while with adoption level at five per cent level. The remaining independent variables like age, type of family, family size, farming experience, land holding, annual income, and social participation had non-significant relationship with both the knowledge as well as adoption level.

Implication: The results showed the significant association between independent variables of paddy growers and their knowledge and adoption level on climate resilient agricultural technologies hence there is an immediate need to promote climate resilient technologies like SRI method, drum seeding, aerobic paddy, alternate wetting and drying etc., focusing more on imparting required awareness, skill and knowledge during the training programmes, demonstrations and other extension activities.

Keywords: Knowledge, Paddy, Climate Resilient Technologies, Adoption, Profile

TECHNIQUES FOR COMPOSTING IN AGRICULTURE
MUDDANA SRI SAI CHARAN SATYA¹, SANJAY-SWAMI¹, M S V
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Due to continuous use of fertilizers there is a decline in soil health and fertility so composts are being used. The concept of waste recycling through composting process can be grouped into Traditional and Rapid methods. Professor F.H. King of the U.S. Department of Agriculture toured China, Japan and Korea in the early nineteen- hundreds and published his findings in farmers of forty centuries in which he described the use of manure(both animal and human), canal mud, green manure and composts in maintain soil fertility and mentioned about composting in his book. Sir Albert Howard took kings writings into account and developed Indore method of composting. Later so many scientists developed different methods of composting by anaerobic and aerobic methods such as Indian Bangalore method (developed by C.N. Acharya), Composting of manure piles, Chinese rural composting, Wind row composting, Rapid composting techniques by Shredding and frequent turnings(The Berkley Rapid Composting Method), Use of Mineral Nitrogen activator(North Dakota State University Hot composting), Use of Effective Micro-organisms(EM based Quick Compost Production Process), Use of Cellulolytic Cultures (IBS Rapid Composting Technology), Use of Forced aeration(Aerated static pile), In-vessel composting, Use of Worms (Vermi-composting) and so on. A part from this there are also a newly developed enriched composting techniques called phospho- sulpho – nitro compost and enrichment with bio- inoculants (such as enrichment with *Azotobacter chroococcum*, *Azospirillum*, PSB, some of the microorganisms(*Trichoderma sp.*) can be used as compost accelerator to enhance composting. Of all the methods EM based composting techniques is better and can be adopted by farmers as it is better on cost basis and the composting time is also less. Taking some of factors into consideration the Rectangular agitated bed composting and In vessel composting are the best as they involve mechanized equipments and also less labour is required. Apart from these many other methods are also present such as Kraal method, Nagpur pit method, NADEP method, sugarcane trash composting, Coir pith composting etc. Hence composting can be used as a way to reduce the waste and can be beneficial to agriculture.

SOIL SWAPPING: A NOVEL TECHNIQUE FOR BETTERMENT OF SOIL AND CROP
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Enhancing nutrient use efficiency and maintenance of soil health are the two major challenges have to be done without losing the soil quality. At present different techniques have been suggested by scientists but some techniques which are having farmers origin always been found practical as per as the execution consequences are concerned. Soil swapping is one of such farmer originated novel technique, which is patented by Karnataka farmer Chintala Venkat Reddy. According to C.V. Reddy, Soil swapping is a technique of changing the top soil with sub soil from other farmland where different crop is grown. With soil swapping there is no compelling reason to apply any

manure, pesticide or insecticidal spray. Everything is taken consideration by the nature. Further farmer or grower will encounter tremendous decrease in the creation cost with this technique. This patented technology has several benefits specially in orchard growing. Another implication of this technology on soil properties must be studied further. Swapped soil may also have positive impact on physical, chemical and biological properties of the soil. Technique holds enormous potential in assets conservation of the era. Further investigation should be encouraged for the bringing sustainability in production through such innovative technologies.

Key words: Soil swapping, soil health, soil quality, nutrient use efficiency.

**FIRST REPORT ON SUCCESSFUL TRIPLOIDY INDUCTION IN GOLDEN MAHSEER
(TOR PUTITORA) USING THERMAL SHOCK**

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Chromosome manipulation is a feasible technology to achieve aggressive somatic growth and disease resistance. Therefore, the present study was conducted to investigate the effect of thermal shock for triploid seed production of Golden Mahseer (*Tor putitora*). An attempt has been made to assess the response to thermal shock to the newly fertilized eggs to conduct triploidy induction. For retaining the second polar body the fertilized eggs (3min post fertilization) were exposed to cold shock 7°C for 45 min and heat shock 36°C for 5 min and 40°C for 2.5 min. Status of ploidy was confirmed by karyotyping and size of erythrocytes. The triploidy rate was observed maximum 68% in 40°C followed by 36°C (59%) and 7°C (45%). The hatching rates were decreased drastically (8%) in cold shock 7°C followed by 48% in heat shock at 40°C and 31% in heat shock at 36°C, while the hatching rate was recorded highest 68% in control group. The results revealed a successful induction of triploidy in golden mahseer using thermal shock. During oogenesis a small cleavage formed concomitantly is known as polar body. The aim of this experiment is to obtain triploid golden mahseer by suppression of second polar body by applying sub-lethal treatments to newly fertilized eggs with the help of thermal shock (heat shock or cold shock) exposure.

Key words: - Chromosome manipulation, karyotyping, thermal shock, triploidy manipulation.

**AN APPROACH TOWARDS THE CONSERVATION AGRICULTURE IN INDIA USING
BEST AGRONOMIC AND SOIL MANAGEMENT PRACTICES**

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The chapter review had been made on the comparative study of conservation agriculture over conventional agriculture practices on ample of observation and results whenever amplification is made for any conventional agricultural practices from various corners of soil management, agronomical practices and economical concepts, it gives a ray of conservational agricultural which stabilizes and maintain equilibrium between biotic and abiotic components of disturbed ecosystem. Some of the sub-heads under this manuscript might be novel, but its associate practices had long been employed by the scientist, farmers and the reason for the adoption and non-adoption had been

advocated by the social-scientist from very long. Even though, there are few variables that regurly explains the adoption of conservational agriculture across the globe. Identifying such variables through further review we, finally promotes conservational agricultural practices not only it is liable but perhaps reasonable.

Keywords: Conservational Agriculture, Conventional Agriculture, Agronomic Management, Soil Management, Zero Budget Farming.

**STANDARDIZATION OF TIME OF INARCHING IN JACKFRUIT
(*ARTOCARPUSHETEROPHYLLUS* L.) UNDER THE TARAI REGION OF
UTTARAKHAND**

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Vegetative propagation through grafting is the recommended method for most fruit crops including jackfruit (*Artocarpusheterophyllus* L.). It involves the joining of scion and rootstock where the rootstock develops into the root system while the scion develops the upper fruiting part of the grafted tree. The present experiment was carried out at Horticulture Research Centre Patharchatta, G.B.P.U.A.T., Pantnagar, (Uttarakhand), during 2018 to 2019 under *Tarai* region of Uttarakhand with a view to find out the most favourable time of inarching in jackfruit. The experiment was laid out in factorial randomized block design with four replications in each treatment. There were 10 grafts in each replication in all 12 treatment combinations. The treatment combinations comprised of 12 dates of inarching (15th of each months) during February, 2018 to January, 2019. The 'Pant Garima' jackfruit were used for inarching scions on one-year old seedling rootstocks. The results of the present study indicated that the effects of inarching time had a significant influence on survival of inarch and all parameters of plant and root. Inarching performed in the month of July recorded highest survival percentage, length and diameter of new growth, number of primary branches, number of leaves, length of primary roots and dry root: shoot ratio at 90 DAG, followed by August and June. Whereas the minimum survival percentage and other parameter were noted during the November to January inarched plant.

**COMPARATIVE ECONOMIC ANALYSIS OF BORROWER AND NON-BORROWER
TURMERIC FARMERS IN ERODE DISTRICT, TAMIL NADU
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India is the largest producer, consumer and exporter of turmeric in the world and its value added products play a vital role in the world trade. The present study was conducted to examine the differences in input use, costs and returns of the borrower and non-borrower turmeric farmers. Two forty samples from bhavani block under erode district were selected for the study. 120 for borrower and 120 for non-borrower was selected. The objective of the study is to assess the credit gap for crop loan availed by marginal and small farmers. Analysis used for the study is cost of cultivation. The results revealed that human labour occupies a major share followed by fertilizer and manure, sucker cost, interest on working capital, insecticide, irrigation charges, machine labour, animal labour and so on. Similar trend was observed in non-borrowed farms. Though the scale of finance offered by commercial banks is adequate for turmeric cultivation, a positive deviation was witnessed for efficient turmeric farmers. Hence, Government should take necessary efforts in creating custom hiring centers (CHC), it may help to reduce the labour usage and cultivation cost.

Keywords: Turmeric, Borrower, Non-Borrower, Cost of Cultivation

**DOUBLING FARMERS INCOME IN HORTICULTURAL CROPS IN CONTEXT OF
POST COVID-19 ERA
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Horticulture contributes to more than a third of the agricultural GDP of the country, though it occupies less than a fifth of the cultivated area. This stems from the fact that there is very high demand and a continued growth in consumption of fresh produce like fruits and vegetables. Floriculture is another growing subsector of Horticulture. Therefore, improving the income of the rural populace engaged in horticultural cultivation is a necessity in order to improve the economy of India. Doubling Farmers Income has been a topic of discussion for quite some time. Farmers who play a vital role in the Indian economy are mostly not aware of this Central Government strategy of doubling farmer's income by the financial year 2022-23. A huge amount of sum of the financial budget of the Central government is given for the upliftment of the agriculture and allied sector. However, the outbreak of the recent pandemic due to spread of Covid-19 virus had affected the horticultural farmers to a great extent. Most of the produce being perishable were being wasted on a large scale, owing to the lockdown announced by the government. Government has taken certain initiatives in order to compensate the farmers for their loss. In such a pandemic situation, a huge gap has been created, due to which doubling the farmers' income in horticultural crops by 2022 has become quite challenging, though it is an utmost necessity, in order to improve the economy of the country.

MORINGA THE SUPER FOOD AND ITS POLLINATION ECOLOGY

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Moringa oleifera commonly known as drumstick or moringa is a vegetable native to India. It's the miracle tree whose every part is nutrient packed. They are all great source of Vitamin C, protein, beta-carotene, iron and potassium, which is more packed form of supplements. The dried leaves had crude protein levels of 30.3% and 19 amino acids. This tree is referred to as a miracle tree due to its rich source of certain macro and micro nutrients of great importance in human nutrition. The chemical composition of the different parts of the Moringa tree may vary depending on cultivar and source. M. oleifera leaf, seed and flower have found numerous applications in food. Phytochemicals present included: tannins, steroids and triterpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugars. The local communities use M.oleifera leaves to treat common ailments. Presence of phytochemicals in the extracts, indicate possible preventive and curative property of M. oleifera leaves. The flower of moringa provides both nectar and pollen rewards to bees and getting pollination benefit with them. Honeybees and carpenter bees visited the flowers frequently, touching anthers and stigma. Stingless bees also forage pollen in Drumstick. Among hymenopterans Apis group includes three insects namely Apis cerana indica, A. dorsata, A. florea and Non Apis group includes ten insects. Moringa honey is precious natural product with benefits known throughout the world by its incomparable medicinal values. The products of moringa are sustainable remedy for malnutrition and will be highly suitable to combat hidden hunger during and after COVID-19 pandemic in India.

Key words: moringa, pollinator, honey, nutrients

GLAUCONITE: AN ALTERNATIVE TO POTASSIUM FERTILIZER ASHUTOSH SINGH AND AMIT KUMAR PANDEY

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Glaucosite is an important iron potassium phyllosilicate (mica group) mineral of characteristic green colour which is very friable and has very low weathering resistance. Glaucosite, a clay mineral is an eco-friendly and effective alternative to traditional potassium fertilizers exploited in agriculture. It was used as a source of colouring pigment in the middle age. Glaucosite rocks are interesting as fertilizers owing to high content of potassium that is one of the three main nutrients or crops along with nitrogen and phosphorus. The main source of potassium is potassium salts that are compounds of potassium with chlorine or sulphate ions. These elements negatively affects the soil. Glaucosite does not have such elements which causes negative impact on soil physico-chemical and biological properties. Recent studies showed that glaucosite bearing rocks can be as efficient as traditional fertilizers to increase the yield of crops even with minimum soil cultivation. It also does not leave any harmful elements in the soil like chlorine and is able to release potassium during several agricultural seasons. Glaucosite rocks are wide spread on the territory of the Bakchar iron ore deposit. The Bakchar iron ore deposit is one of the largest deposit in Russia in the world but it has not developed yet. It was suggested that even when exposed to minimal mechanical processing a glaucosite bearing rocks can become the most effective form of potassic fertilizers. Glaucosite has another important advantages that it released only a quarters of potassium. This means glaucosite will keep a positive effect on yields during the next 2-3 seasons. Being natural sorbent, glaucosite helps to retain moisture in the soil.

Key Words: Glaucosite, Potassium, Fertilizer, Soil Properties

METHODS FOR SYNTHESIS OF POLYMERIC NANOPARTICLES MAYA SHARMA¹, P.S. CHAMPAWAT¹, VINOD SAHARAN², S.K. JAIN¹, V.D. MUDGAL^{1,3}

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Nanoscience and nanotechnology have gained significant recognition in terms of application in various fields i.e. energy, environment, engineering, health, cosmetic and agriculture. Polymeric nanoparticles (PNP) are defined as three dimensional nanoparticles/nanocapsules/nanospheres with size in the range of 10-1000 nm. PNP are mostly used in pharmaceuticals along with agriculture and its allied sectors for crop production, protection, management, harvesting, post-harvest processing and packaging due to easy bioavailability, targeted delivery, increased stability of volatile compounds etc. This trend is due to drastic change in properties of particle at nano size. Utilization efficiency of PNP depends upon several factors such as particle size, synthesis method, pH, pressure, temperature, environment, time etc. In order to achieve the properties of interest, the mode of preparation plays a vital role. Synthesis procedures can affect the particle size, shape, porosity, surface area, volume, applicability etc. and can be classified into physical methods, chemical methods and biological methods. The objectives of this review article are to describe the chemical methods for synthesis of PNP along with advantages and disadvantages for particular method.

Keywords – PNP, ionic gelation, nanoprecipitation, emulsion, dialysis, solvent evaporation.

GENETIC DIVERGENCE STUDIES FOR SHOOT FLY TOLERANCE IN POST RAINY SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH)

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Shoot fly (*Atherigona soccata* Rond.) assumed the most important pest of sorghum crop. The losses due to this pest have been estimated to reach as high as 86 per cent of grain and 46 per cent of fodder yield. Host plant resistance combined with timely sowing is the most realistic approach to minimize grain and store yield losses due to insect pests such as sorghum shoot fly. Paramount of variability for resistance to this pest has is present in sorghum germplasm. Therefore, the present study was carried out on a diverse array of sorghum genotypes to identify resistant sources and plant characteristics influencing resistance/susceptibility to shoot fly (*Atherigona soccata*). The material comprised of 116 genotypes and four checks (resistant check IS-18851, susceptible check DJ-6514 and two varietal checks). The germplasm lines were planted in randomized block design with two replications during *rabi* 2015-16 at Sorghum Research Station, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. Observations were recorded on five randomly selected plants in each plot and replication for grain yield, yield contributing traits and following shoot fly tolerant associated traits from each replication. The genetic divergence was estimated by Mahalanobis (1936) D² statistics for 18 quantitative characters. 120 genotypes including 4 checks were grouped into sixteen clusters with variable number of entries revealing the presence of considerable amount of genetic diversity in the material. Among the sixteen clusters, Cluster III was the largest involving 40 genotypes. Out of the 18 characters studied, trichome density at adaxial (43.42.%) and abaxial (39.06.%) contributed maximum towards genetic diversity. The relative contributions of different traits towards genetic divergence was plant height, leaf angle, chlorophyll content, days to 50% flowering, leaf length and grain yield per plant. Cluster II, VI, IX and X exhibiting shootfly tolerant sources as high mean for shootfly resistant parameters may be utilized in future breeding programme. From present study it is concluded that Cluster II, VI, IX and X exhibiting shoot fly tolerant sources as high mean for shoot fly resistant parameters may be utilized in future breeding programme. Genotypes IS 17757, IS 33770, IS 33746, PVR 658 and IS 40269 with less dead heart per cent and shoot fly resistant parameters may be used as promising sources for breeding shoot fly resistant genotypes.

Keywords: Sorghum, Genetic Diversity, Shoot fly, Trichome density, D² statistics

SHOOT FLY TOLERANCE STUDIES IN SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH) GERMPLASM LINES

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Sorghum shoot fly (*Atherigona soccata* Rond.) is one of the major pests, which may cause losses of 86 per cent of grain and 46 per cent of fodder yield. The relationship between host plant resistant and pest is one of the major components, which could control sorghum shoot fly. The knowledge of genetic variability and relationship among various quantitative characters is helpful in deciding the selection criteria to bringing out the possible improvement. The present study was therefore carried out to find out genetic components of variation and correlation for grain yield and shoot fly tolerance attributing traits to formulate an effective selection programme. The material used for this

study was comprised 116 genotypes and four checks (resistant check IS-18851, susceptible check DJ-6514 and two varietal checks). The germplasm lines were planted in randomized block design with two replications during *rabi* 2015-16 at Sorghum Research Station, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. Observations were recorded on five randomly selected plants in each plot and replication for grain yield, yield contributing traits and following shoot fly tolerant associated traits from each replication. Wide range of variation was observed for shoot fly resistance and yield contributing characters. GCV ranged from 3.49% (days to maturity) to 111.53% (abaxial trichome density) and PCV ranged from 3.87% to 111.66%. Higher GCV along with high heritability and genetic advance exhibited by traits dead hearts at 14 and 28 DAE, trichome density (abaxial and adaxial) and plumule & leaf sheath pigmentation. Grain yield per plant exhibited significantly positive association ($P < 0.01$) with plant height, leaf length, leaf breadth, 100 seed weight at genotypic level. While it has shown significantly negative association with dead heart per cent at 14 and 28 days after sowing, days to maturity, no. of tillers and chlorophyll content. Glossiness, seedling vigour, leaf wetness and chlorophyll content were significant and positively correlated with dead heart percentage at 14 and 28 DAE at both the genotypic and phenotypic levels. While it had shown negative significant association with trichome density (adaxial and abaxial) surface, plant height, leaf length, leaf breadth and grain yield per plant at both genotypic and phenotypic level. It is concluded that traits viz., number of trichomes at adaxial and abaxial surfaces of lamina, leaf glossiness, seedling vigour, plumule leaf pigmentation played important role in shootfly resistance and exhibited high GCV, heritability and high to moderate genetic advance and significantly positive association for shoot fly dead heart percent will be effective for improving shoot fly resistance through breeding programme.

Key words: Variability, heritability, genetic advance, correlation, Sorghum bicolor

COMBINING ABILITY STUDIES IN CMS BASED PIGEONPEA (*Cajanus cajan* (L.) Millsp) HYBRIDS

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Fourty hybrids CGMS based pigeonpea hybrids (*Cajanus cajan* (L.) Millsp.) were developed through line x tester mating design involving 5 lines and 8 testers to study the general and specific combining ability effects for yield and yield contributing characters. Total 54 genotypes were (5 lines, 8 testers, 40 hybrids and 1 standard check) evaluated in a randomized block design with two replications at Agriculture Research Station, Badnapur, VNMKV., Parbhani during *Kharif* 2018. Observations were recorded on five competitive randomly selected plants from each row in each replication. High magnitude of variances due to lines and testers against line x tester interaction for the characters indicated the presence of variability. The estimates of components of variance for GCA were higher in magnitude than SCA variances except for pollen fertility and primary branches per plant indicating presence of additive gene action. The estimates of GCA effects revealed that BSMR 736 B, BDN 2004-4 B, BDNHR 1 and BDNHR 35-8 were the good general combiners for grain yield per plant and most of the yield contributing characters. The lines BDN 2004-3 B and tester BDNHR 21-1-1 and BDNHR 36-7 have registered significant negative GCA effect for days to 50 per cent flowering and days to maturity. Among all crosses, BSMR 736 A x BDNHR 22-1-1 manifested maximum positive SCA effect followed by BDN 2004-4 A x BDNHR 35-8 and BDN 2004-2A x BDNHR 24-1-1-1 for grain yield per plant. BDN 2004-1 A x BDNHR 22-1-1, BSMR 736 A x BDNHR 22-1-1 and BDN 2004-3 A x BDNHR 35-8 showed significant negative SCA

effect for days to 50% flowering and days to maturity. On the basis of *per se* performance and general combining ability parents, BSMR 736 B, BDN 2004-4 B, BDNHR 1 and BDNHR 35-8 were identified for their use in potential breeding programmes. Two crosses BSMR 736 A x BDNHR 22-1-1 and BDN 2004-3 A x BDNHR 35-8 showing high *per se* performance, significant desirable SCA effects for grain yield per plant, days to maturity and pollen fertility may be tested in multi location trial for stability and yield performance.

Keywords: Pigeon pea, combining ability, male sterility, yield

DIVERSITY OF PHYTOPLANKTON IN SOME DOMESTIC WASTEWATER-FED URBAN FISH POND ECOSYSTEMS OF HISAR, HARYANA, INDIA
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This study was designed to determine the phytoplankton diversity and abundance in five domestic wastewater-fed fish ponds of Hisar (Haryana). The results showed that the number of species in the ecosystems depends on the area and volume of the water body and the level of plankton primary production. A total number of 43 phytoplankton taxa representing four classes, namely Cyanophyceae (7), Chlorophyceae (29), Bacillariophyceae (5) and Euglenophyceae (2), are thriving in these ponds which may suggest that different nutrient-rich wastewater supports the diversity and abundance of the phytoplankton. Different values of diversity indices, results of post hoc analysis and rarefaction curve are depicted spatial variations of phytoplankton abundance and physicochemical factors. The canonical correspondence analysis presents that most of the phytoplankton species densities are associated with higher values of the physicochemical variables in these ponds.

Keywords: Phytoplankton, anthropogenic activity, diversity indices, diversity, richness, abundance, evenness and seasonal fluctuations.

GENETIC DIVERSITY AMONG ELITE SORGHUM (*Sorghum bicolor* L.) ACCESSIONS GENOTYPED WITH SSR MARKERS TO ENHANCE USE OF GLOBAL GENETIC RESOURCES

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Analysis of genetic diversity, selection of parents with diverse genetic base having contrasting phenotype is an important step in developing mapping populations for QTL detection, association mapping and MAS studies for crop improvement. To elucidate the diversity among Marathwada (Maharashtra) region cultivated sorghum accessions we studied genetic diversity in elite 20 sorghum accessions using SSR molecular markers. The objective of the study is to evaluate the diversity among the Sorghum accessions and their further use plant breeding for the breeding purpose. The polymorphism information content (PIC), a measure of gene diversity present in the selected population, varied from 0.38 to 0.72 with an average of 0.55 and was significantly correlated with number of alleles. Clustering analysis based on the unrooted phylogeny using neighbour-joining (NJ) method, bootstrapping of the data (10,000 permutations) as implemented in POWERMARKER grouped the 20 accessions into three distinct clusters and grouping was in good agreement with biological status and some important traits of sorghum accessions. The SSR loci msbCIR306, Xtxp321, msbCIR329, Xcup02 and Xisep0310 were rich in allelic diversity exhibiting highest PIC value across the Sorghum accession originated from Marathwada region.

EXPLORING VIRUSES IN FRUIT CROPS

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Plant viruses cause considerable economic losses and is a threat for sustainable agricultural production worldwide, resulting in huge monetary loss every year. The frequent emergence of viral disease is mainly due to international trade, climate change and ability of viruses for rapid evolution. Fruit trees constitute a very important part of agricultural economy worldwide. They are susceptible to many plant viruses with some of them causing severe diseases, crop losses and reducing the productive life of their fruit trees host plants. The movement of propagative material across the borders has facilitated the spread of fruit tree viruses and their insect vectors worldwide. High density planting coupled with low genetic diversity has made the crops vulnerable to attacks by viruses and other pathogens. To effectively control viral diseases and prevent its spread, early and accurate detection is essential. A number of molecular techniques like PCR, southern blotting, DOT blotting, northern blotting and western blotting etc have been used for timely detection of viruses in plants. The advent of molecular techniques has resulted in early detection of viral diseases in crops like papaya, banana etc. The last few years the use of next generation sequencing (NGS) technology has increased the number of virus species detected and in some cases these viruses were identified as the causal agents of known diseases having previously unknown etiology. The NGS technology has also increased the number of virus sequences deposited in the data bases and this also helped to improve their molecular diagnostic tools and studies on their genetic diversity.

Keywords: virus, plant, fruit, NGS, molecular, losses, detection

POTENTIAL APPLICATION OF REMOTE SENSING IN HORTICULTURE

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Horticulture sector is a major driver for the growth of Indian agriculture. Horticultural crops, especially fruits and vegetables play a significant role in the food and nutritional security. Hence, it is necessary to increase both production and quality of horticultural crops. For enhancing fruit production, frequent of orchard is essential which is very difficult because of large area coverage. Remote sensing is one of the emerging advanced technologies to gather accurate information on different parameters required for crop husbandry. It is process of obtaining information about land, water, or an object without any physical contact between the sensor and the subject of analysis (Remote – Not in contact with an object and Sensing – Getting information). Geospatial applications for horticultural development include post-harvest infrastructure, Aqua-horticulture, Orchard rejuvenation, Crop intensification, GIS database creation, Site Suitability assessment etc. CHAMAN is one of such projects initiated under MIDH programme responsible for the assessment of the same. Remote sensing technology has developed from balloon photography to aerial photography and then advanced to multi spectral satellite imaging. However, availability of reliable statistics in context to area of a particular crop grown, information for site suitability, market planning and export strategy is need of the hour for better utilization of remote sensing technology. Recently several remote sensing technologies like RS-GIS, IRS-LISS III, and NDVI etc are in use for analysis suitable soil, crop area, canopies etc. Several other applications including mapping of

orchards, precision farming, detection of pest and disease infestation, assessment of quality etc. However till date it is applicable in few perennial crops. Hence, work should be done in all horticultural crops in near future.

Keywords: fruit, remote sensing, crops, technology, satellite

NUTRIENT AVAILABILITY OF SOIL AS AFFECTED BY LONG TERM ZERO TILLAGE AND DIFFERENT MOISTURE REGIMES IN LEGUME BASED CROPPING SYSTEMS OF NORTH-WESTERN INDO-GANGETIC PLAINS

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A Field experiment was conducted entitled “NPK availability of soil as affected by long term zero tillage and different moisture regimes in legume based cropping systems of north-western Indo-Gangetic Plains” during 2017-18 and 2018-19 on an on-going long term experiment on ‘Effect of varying moisture regimes in zero-till wheat succeeding mungbean and sorghum’ since 2006 at, CCS HAU, Hisar. The experiments consisted of two cropping systems (mungbean-wheat, MW and sorghum-wheat, SW), three tillage practices viz. CT-CT (conventional tillage in both kharif & rabi seasons), CT-ZT (conventional tillage in kharif & zero tillage in rabi seasons) and ZT-ZT (zero tillage in both kharif & rabi seasons); and three moisture regimes {IW/CPE = 0.60(M0.60), 0.75 (M0.75) and 0.90 (M0.90)}. The available nitrogen was significantly higher in mungbean-wheat cropping system (26.49 and 21.20 %) as compared to sorghum-wheat cropping system in surface and sub-surface depths, respectively. It was significantly higher in ZT-ZT (91.58 and 43.39; 36.99 and 36.10 %) and CT-ZT (29.15 and 11.35 and 15.02 and 12.79 %) as compared to CT-CT over all the moisture regimes under mungbean-wheat and sorghum-wheat cropping systems at surface and subsurface depths, respectively. In present study, available nitrogen was significantly higher at M0.90 (20.08 and 19.82; and 65.65 and 52.09 %) and M0.75 (14.12 and 13.04; and 42.64 and 37.88 %) as compared to M0.60 over all the tillage practices in mungbean-wheat and sorghum-wheat cropping systems at surface and subsurface depths, respectively and decreased with soil depth. Same trend was followed in case of available phosphorus and potassium. Therefore Long term zero tillage with inclusion of legumes can be a promising alternative to sustainably increase availability of nutrients in soil for cereal-cereal cropping systems which ultimately plays a pivotal role to sustain the crop productivity and optimum ecosystem functioning with improving soil health.

Keywords: Zero tillage, moisture regimes, legumes, soil health, sustainability, available nutrients



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